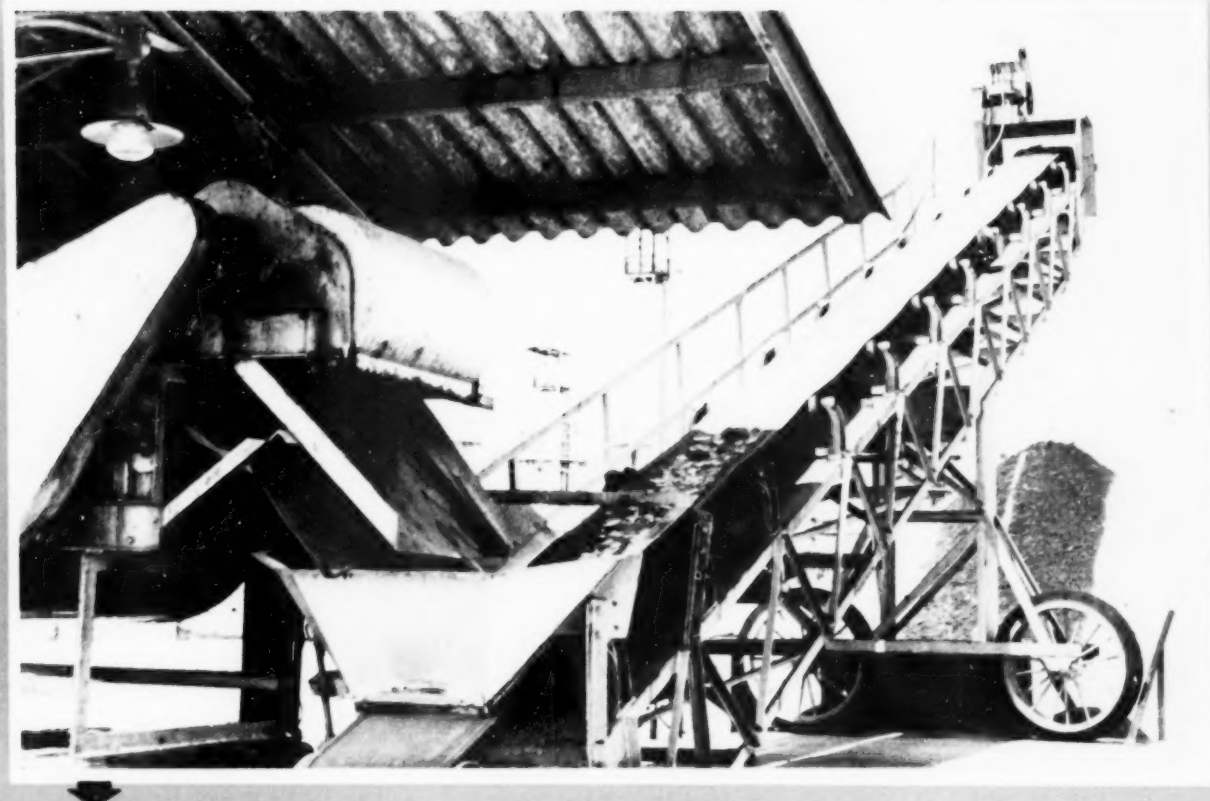
PETROLEUM PROCESSING

including Petrochemical Processing Section

MARCH 1953



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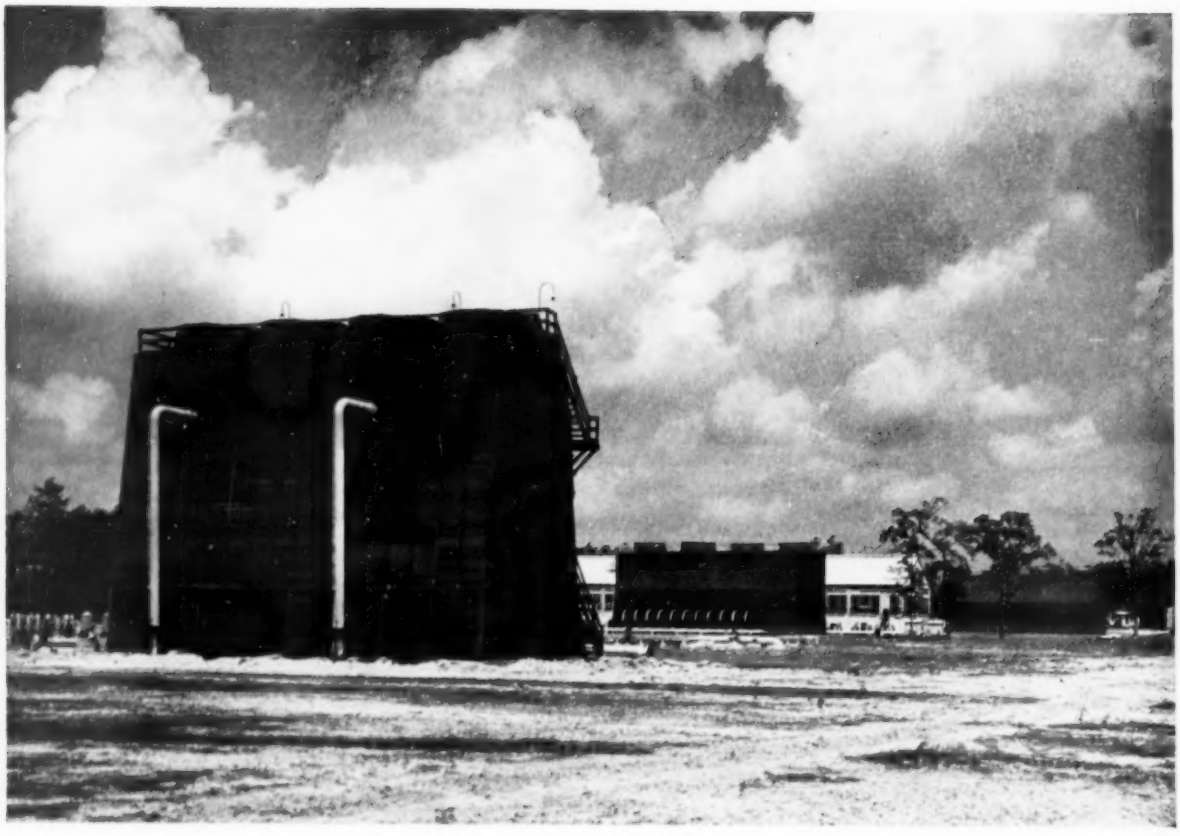

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The three cooling towers pictured above are a part of EIGHTY large Hudson cooler installations made by a gas transmission company—installations involving HUDSON cooling towers, atmospheric sections and HUDSON Solo-aire units made in eight different states from Texas to New York.

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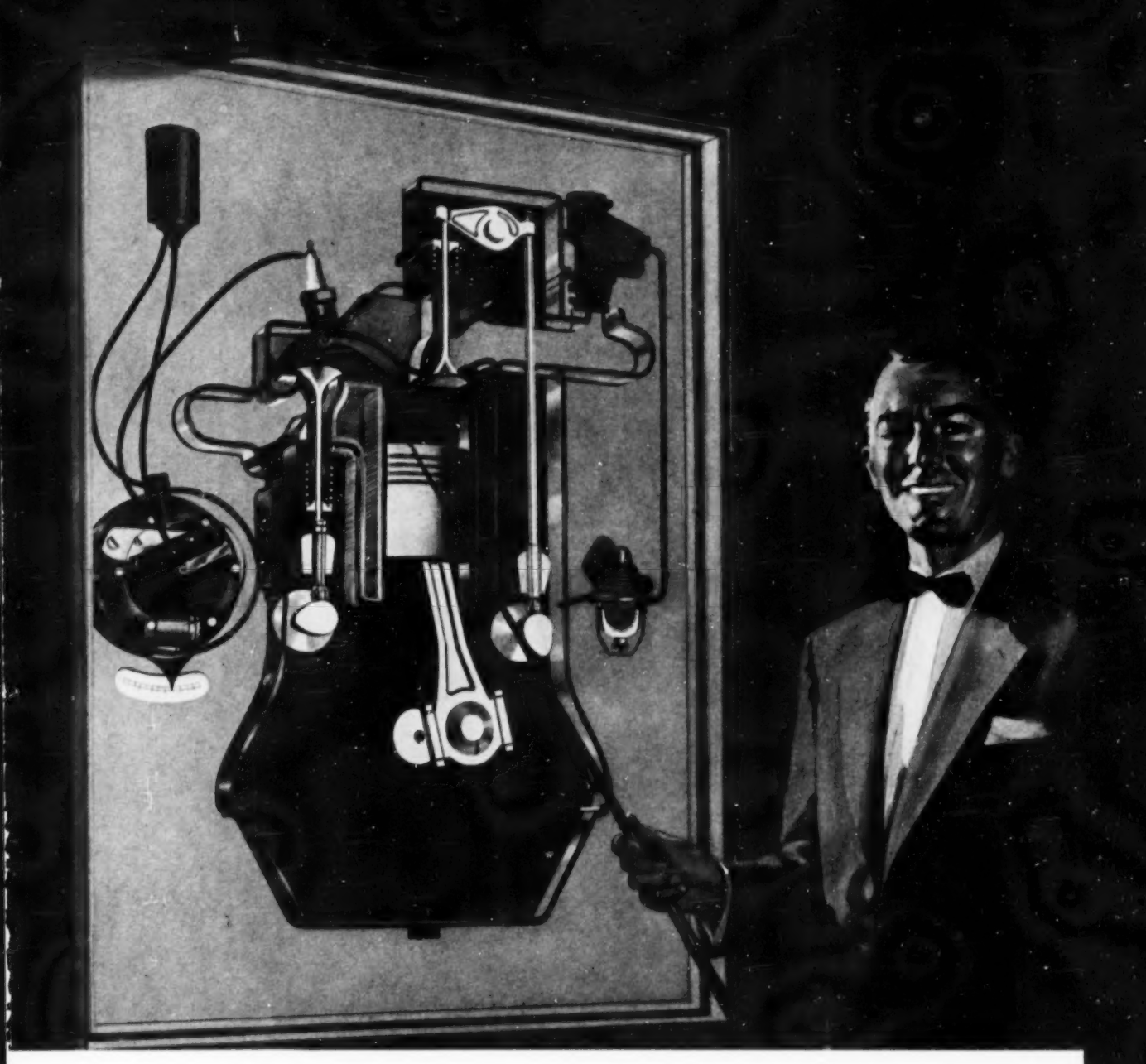

How to tune up a service station salesman

Today, it takes more than a snappy uniform to make a good service station salesman. He must know his business.

And knowing his business means a good working knowledge of automobile engines, fuels, lubricants, and TBA items. This is the kind of knowledge that helps him do a better selling job.

That's why Ethyl developed the Product Sales Clinic—a special service station training program that fits right into your own training plans. It is designed to give your dealers and salespeople the down-to-earth facts they need.

Judging by results, it has proved to be one of Ethyl's most valuable services. In the past year alone, we put on 612 request showings of the Product Sales Clinic. More than 50,000 service station salesmen attended.

(Continued on next page)

ETHYL
ETHYL CORPORATION

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How to tune up a service station salesman

(Continued from preceding page)

Since the program began, more than 150 oil companies have sent their dealers and marketing people to the Clinic to learn more about the products they sell. Every oil company that has scheduled the Product Sales Clinic is enthusiastic. Here are two typical statements:

> ***". . . comments from numerous people attending these (Ethyl) shows were conclusive proof that we can expect increased sales, not only of our gasoline and oil, but of our TBA items as well."***
>
> ***". . . the program you put on was one of the finest I have ever seen, and I hope many more of our people may see this very same thing."***

Experiences like this throughout the country make us feel that even your best salesmen can do a better job with the benefit of an occasional "tune-up." Ask your Ethyl representative about scheduling the Product Sales Clinic in your territory.

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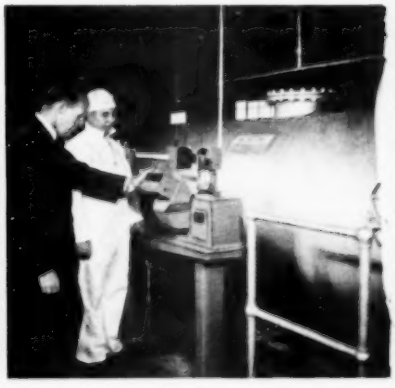
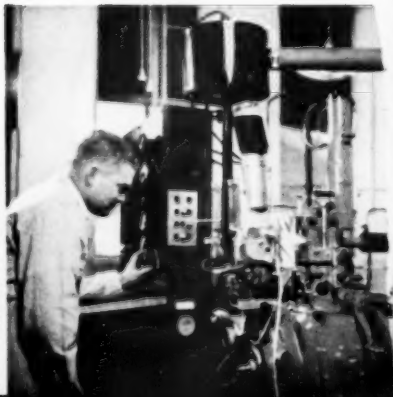


SAFETY SERVICE

GASOLINE TESTING



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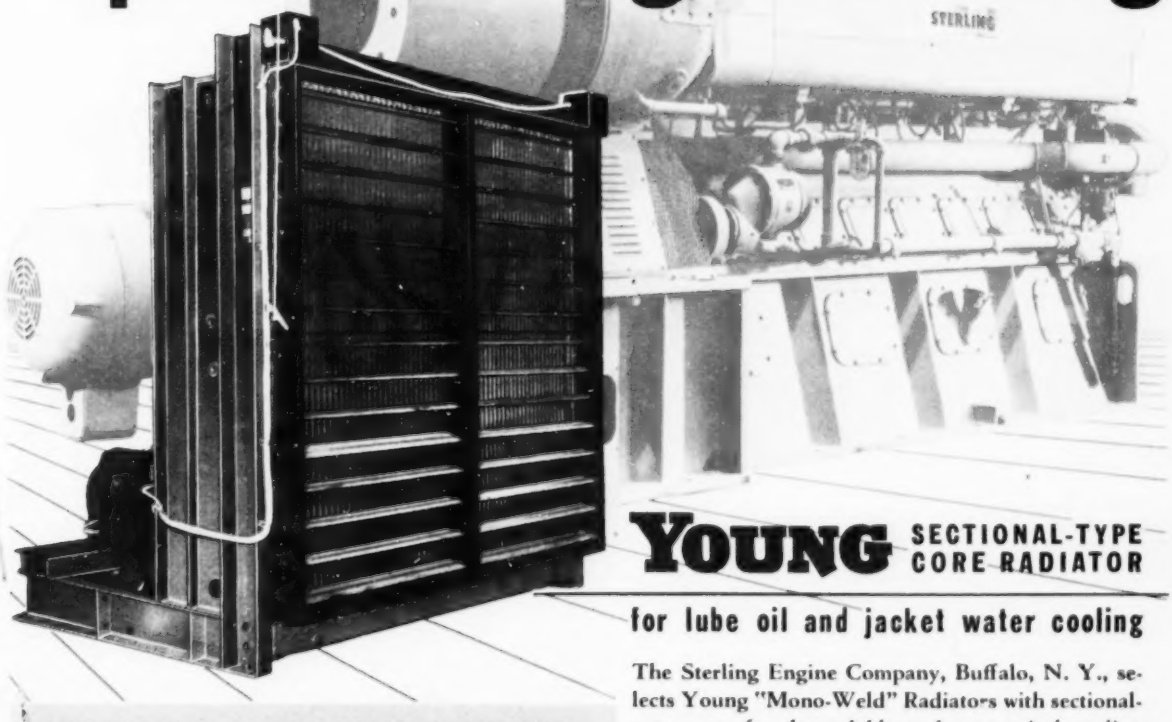

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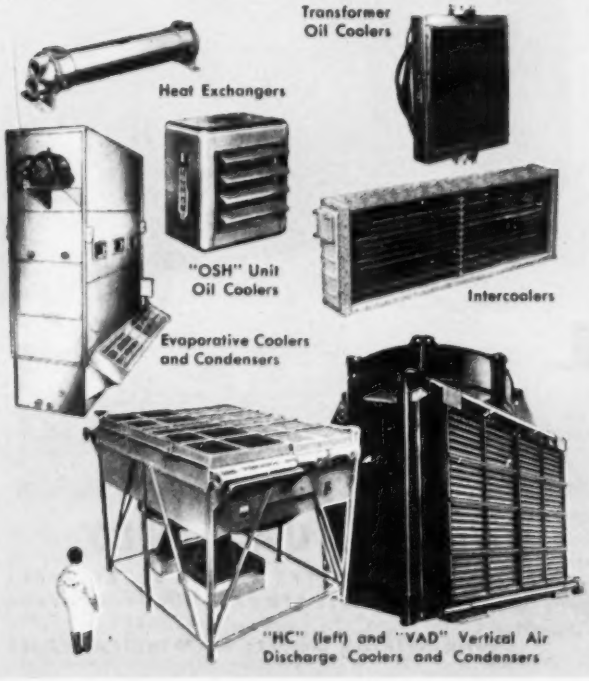
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PETROLEUM PROCESSING

Covering petroleum and petrochemical research and the design, construction, management, operation and maintenance of plants processing hydrocarbon materials into fuels lubricants and chemicals.

March, 1953
Vol. 8, No. 3

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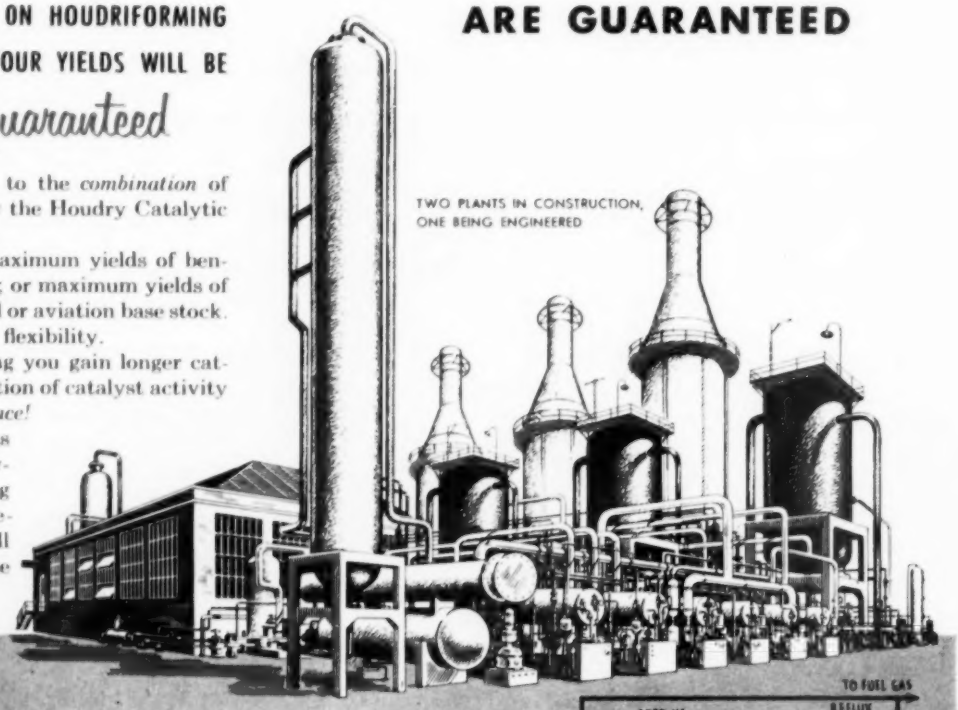
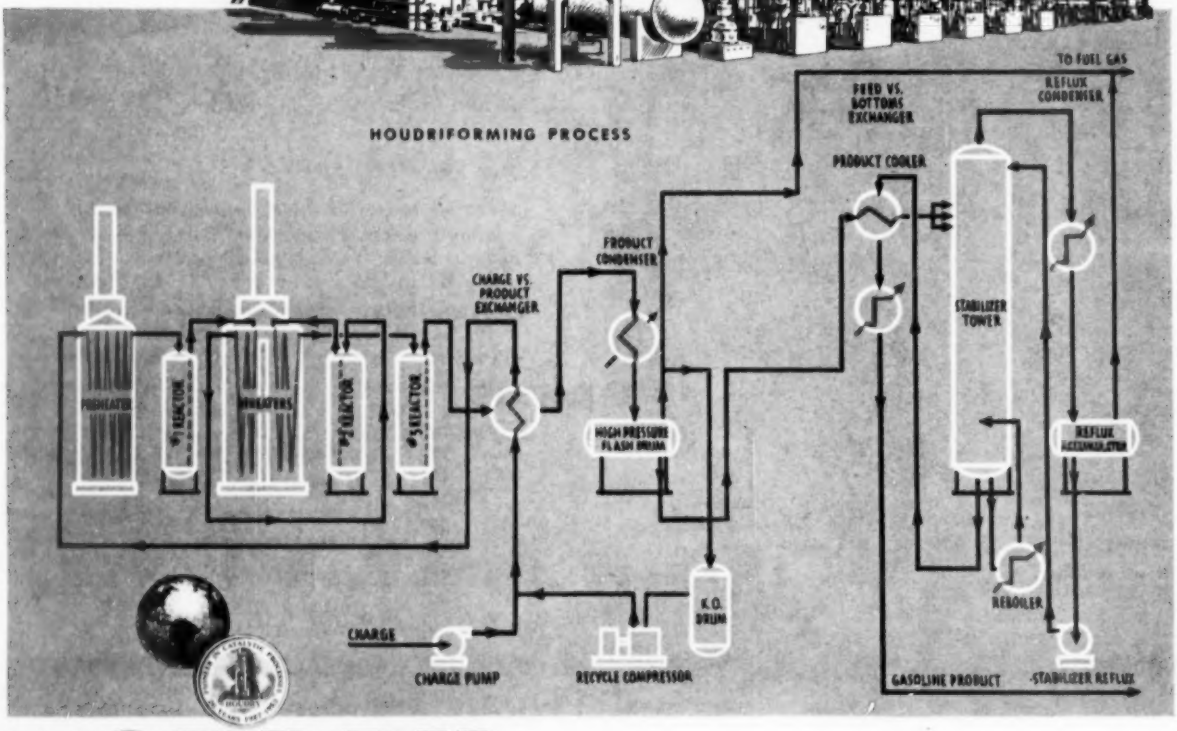


TWO PLANTS IN CONSTRUCTION, ONE BEING ENGINEERED



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PETROLEUM PROCESSING

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We Join the McGraw-Hill Family

WE editors of PETROLEUM PROCESSING feel that our readers have much to gain from the acquisition by the McGraw-Hill Publishing Co., effective April 1, of the publications and services of Warren C. Platt, which includes this journal.

The Platt Publications will become a petroleum unit of the McGraw-Hill company. Mr. Platt continues as publisher of PETROLEUM PROCESSING and it will be edited by its present staff. The editorial policies will hold to the present standard, of bringing to men engaged in petroleum processing operations reports and articles on the timely technological and other developments that will be helpful to them in their work.

In addition, our becoming a part of the largest publisher of technical and business journals in the world provides the means for us to call on the experience and background of the large trained staff of McGraw-Hill, to further improve the news, articles and features which PETROLEUM PROCESSING will carry. New specialized information sources will be available to us, together with the services of corps of artists, illustrators, chart makers and others skilled in the techniques of industrial journal publishing.

Both publishing firms have long years of experience back of them in their respective fields. James H. McGraw, Sr. started business paper publishing in 1889, with a magazine in the street railway field. Publications of McGraw-Hill now cover business and industry and many scientific fields. Many of our readers are already well acquainted with one or more of the company's journals but few of them know, we will venture, that the affiliated McGraw-Hill Book Co., Inc. is the largest publisher of technical books in the world.

The experience of Warren C. Platt in the business paper publishing field likewise goes back many years—to 1909 when he started *National Petroleum News*. There was not much in the way of refining news then but what developed was reported in its pages. Along in 1915 your editor started to make trips for *NPN*, visiting the "teakettle" refineries in the Mid-Continent fields to report what was going on there. By the early days of World War II, the volume of technical material concerning refining had so increased that it was published as a separate section of *NPN*. PETROLEUM PROCESSING was launched in 1946 and there is no need to tell most of our readers of its growth.

Our contacts thus far with the editorial heads of the McGraw-Hill Publishing Co. have demonstrated a mutual purpose—to continue to improve PETROLEUM PROCESSING in its helpfulness to its readers. Thus its editors take pride in the announcement of the new ownership.

Virgil Guthrie

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The weekly oil marketing magazine, covering news, prices, transportation, storage, merchandising

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What's Happening . . .

Refinery Expansion

. . . **More lube oil facilities** are needed, according to Deputy Petroleum Administrator for Defense J. Ed Warren. Recent survey by PAD indicates that 182,000 b/d capacity expected by beginning of '54 will be only 4,000 b/d above capacity at beginning of '52. Expansion goal set up in 1951 called for 28,000 b/d capacity expansion. Existing capacity will be more than sufficient to meet both domestic and export demands under present conditions, Warren said, but would not be enough in all-out war.

. . . **Formal expansion goals for '54 and '55** probably will not be set by PAD, in view of easing of materials controls now and likely total termination by June 30. PAD official has pointed out that such expansion programs can be made effective only under Defense Production Act with its authority for materials allocations among various users and rapid tax amortization program. PAD will probably, however, continue its studies on industry needs and recommend certain rates of expansion.

. . . **Imperial Oil Ltd.** has completed engineering design for a new lube plant at its Edmonton, Alberta, refinery. Preliminary cost estimates are in excess of $10 million, with the plant to have an annual capacity of 750,000 bbl. of lubricants. Facilities will include solvent extraction, solvent dewaxing, finishing and packaging units. Construction is expected to be under way in early '54, with a completion target of mid-'55. The refinery itself was first built in 1948 and now has a capacity of 22,600 b/d.

. . . **Esso Standard Oil Co.** has awarded contract for engineering and construction of 60,000 b/d three-stage crude distillation unit at its Bayway, N. J. refinery to M. W. Kellogg Co. (What's Happening, Feb. '53, p. 151). Unit is similar to two now under construction by Kellogg at Esso's Baton Rouge, La., refinery. Engineering is underway and erection will commence in early summer.

. . . **Malco Refineries** has acquired substantial portion of stock (with option on balance) of New Mexico Asphalt & Refining Co., and may boost capacity of latter's refinery at Artesia, N. Mex. from 8,000 to 10,000 b/d. Malco presently has its own 2,500 b/d refinery at Roswell, N. Mex.

. . . **Imperial Oil Ltd.** has started a $6-million program for building three new service facilities at its Sarnia, Ontario refinery—a quality control laboratory, mechanized packaging and shipping plant, and centralized machine shops. The new control laboratory will be a 2-story building with 30,000 sq. ft. of working space; site clearing has begun and completion is expected by early '54. The new packaging and shipping plant will have 60,000 sq. ft. of space, and the new mechanical shop 61,360 sq. ft.

. . . **North Star Oil Ltd.** plans to expand and modernize its 4,200 b/d refinery at St. Boniface, Manitoba. Initial project will be a catalytic cracking unit, at an estimated cost of $5-6 million.

Petrochemicals

. . . **Vosco Industrial Chemical Products Ltd.**, a new firm, has started operations in the first plant in Canada to produce synthetic detergents, outside Montreal, Quebec. Detergents include alkyl-aryl, lauryl, high alcohol and fatty condensate types, the basic raw materials being dodecylbenzene and lauryl alcohol from the U.S. A new continuous sulfonation process developed by O. V. Vrany, president of Vosco, is being utilized.

. . . **Ethylene oxide and ethylene glycol** are the products of a new process developed by Shell Development Co. and now being made available in the U.S. through the Lummus Co. The process employs direct oxidation of ethylene for the manufacture of ethylene oxide, and hydration of the oxide to produce ethylene glycol. It is the result of work started several years ago by Shell, and is now ready to be employed on a commercial scale.

. . . **Continental Oil Co.** has purchased plant and facilities of Bryton Chemical Co., Trainer, Pa., marking further step in expansion of Continental in the petrochemicals field in providing new line of chemical products and help meet demand for synthetic oil-soluble sulfonates. Products will continue to be marketed under Bryton name and management personnel will be unchanged.

. . . **Morton-Withers Chemical Co.** is expanding its original petroleum sulfonates pilot plant at Greensboro, N. C. to bring it up to commercial-scale operations—with an anticipated output of 20 million lbs. annually. On new sulfonates plant projected for Gulf Coast (What's Happening, Apr. '52, p. 408) construction is expected to be started this year.

. . . **Lubrizol Corp.** will build a new plant near Niagara Falls, Ontario to produce a full line of motor oil and gear lubricant additives for Canadian refiners. Plant site, 17 acres, has been acquired, and completion is expected by the end of '53. Operation will be handled by a subsidiary—Lubrizol of Canada, Ltd.

. . . **Sale of government's synthetic rubber plants** is one step closer, with submitting of disposal plan to President and Congress by Reconstruction Finance Corp. Facilities include 29 plants for manufacture of rubber and its components, with total annual capacity of 860,000 tons of GR-S and 90,000 tons of Butyl rubber. Proposed plan provides for public notice inviting "indications of interest" for purchase of facilities. At end of specified period, agency designated by Congress would negotiate with bidders.

. . . **Greater use of Butyl rubber** in tire carcasses and treads is forecast by Reconstruction Finance Corp. Butyl thus far has been used primarily for inner tubes, but is already being used in tubeless tires. Because it is cheapest of synthetics, there is likely to be widespread use of it, RFC thinks.

Information on these pages is obtained through the nation-wide news coverage service of PLATT'S OILGRAM NEWS

. . . **Nonyl phenol** is now being produced by Jefferson Chemical Co. in a new process unit just put into operation at its Pt. Neches, Texas plant. The chemical is finding increasing use as an intermediate in the manufacture of non-ionic surface active agents, rubber chemicals and lubricating oil additives, and as a starting material in the preparation of certain resins and plasticizers.

. . . **Diamond Alkali Co.** announced Feb. 13 that it had taken, a 60-day option either to purchase the stock of Belle Alkali Co., Belle, W. Va., or to acquire the right to use the Belle process for the chlorination of methane. Belle presently employs the process in its plant for the manufacture of methyl chloride, methylene chloride and chloroform.

. . . **Shell Petroleum Co., Ltd.** has completed its new petrochemical plant at Berre, France, with a capacity of 7500 tons annually of acetone and mixed solvents. Raw material is propylene from refinery gas of Shell's nearby refinery.

. . . **Phillips Chemical Co.** is expanding capacity of its natural gas-to-ammonium sulfate facilities at Houston from 750 tons/day to 1000 tons/day. Completion is expected by Dec. '53.

Markets, Prices

. . . **Government price controls ended** Feb. 13 on all petroleum products except No. 2 heating oil, and California and Pennsylvania crude oil prices rose subsequently. Gasoline prices were hiked from 0.4 to 0.8c per gal. by some marketers in New York state and New England. On the other hand, declines in prices generally were the order of the day in the Midwest and Mid-Continent, with distillates, heavy fuel, natural gasoline, and some lubricating oils quoted lower. No. 6 fuel at New York harbor was off 10c per bbl. to $1.90, although majority of suppliers continued to quote $2.00 for tank car and barge lots.

. . . **On the West Coast,** Standard of California announced increases in its postings for crude ranging from 10c per bbl. for low gravities up to 50c for 35 gravity and above. Simultaneously, the company boosted its prices for gasoline 1.6c per gal., distillates 1.8c, and heavy fuel 10c per bbl. in its Pacific Coast marketing area. Standard's move was followed on the West Coast by all principal crude buyers and marketers of refined products.

. . . **In Pennsylvania,** Joseph Seep Purchasing agency of South Penn Oil Co. increased its posted prices for Penna.-Grade crudes 15c per bbl. New prices for oil in the Bradford-Allegany district is $4.40. Unlike California, prices for refined products in Western Pennsylvania failed to increase following the boost in crude.

. . . **On the East Coast,** Socony-Vacuum Oil Co. reported increases averaging 0.5c per gal. in its wholesale prices for gasoline at points in New York and New England. Company said that during the two years of control it had spent "large sums to raise quality," adding that operating costs during the interim also had risen substantially.

. . . **In the Midwest,** on the other hand, price declines were widespread. A comparison of low reported quotations at the beginning and end of February showed that range oil in the Chicago district was off from 10.9c to 10.75c, No. 2 fuel from 9.9c to 9.875; and No. 6 from 5.7c to 5.45c per gal. For Group 3 basis tank car shipments, refiners' quotations fell from 8.75c to 8.5c for kerosine, from 7.625c to 7.25c for No. 2 fuel, and from $0.90 to $0.85 per bbl. for No. 6. Grade 26-70 natural gasoline was off in the same period, "about a month ahead of schedule," from 6.375c to 5.5c, Group 3.

Industrial Mobilization

. . . **Status of materials controls** for petroleum industry was still in doubt at end of month. Decontrol of "civilian" materials after June 30 was announced Feb. 23, with plan to continue materials controls beyond that deadline to assure completion of military build-up if Congress passes necessary legislation. But no indication has been given as to what materials or industrial activities would be considered essential for completion of military build-up, although presumably they would include alkylate and avgas operations.

. . . **Military demands for avgas** will not level off until 1957-58, according to Col. Douglas Brown of Armed Services Petroleum Purchasing Agency. Although military is turning to jet planes to great extent, it still is ordering large numbers of propeller craft, including transports and air tankers for refueling jets, he said.

. . . **Relaxed jet fuel specs** may be in the making. Navy has indicated it will be ready soon to get the oil industry's viewpoints of revised specifications, in response to industry protest in past that current specs are too stringent. Coordinating body probably will be National Petroleum Assn. Navy also is understood to be giving serious consideration to possibility of utilizing selected cracked Diesel oils, rather than insisting on straight run product.

. . . **PAD's staff is being cut,** and as of April 1 will total only 189 employes compared to 338 a year ago. Reduction includes abolishment of Gas Planning Division, effective Feb. 27. No other immediate reductions are planned, however, according to PAD J. Ed Warren.

Miscellany

. . . **Octane rating requirements** for regular-grade "R" gasoline for shipment in Great Lakes Pipe Line are increased one-half number to 83.5 beginning Mar. 13, with maximum lead content allowed remaining at 2 cc. Recent proposal to boost "R" grade one full number to 84 octane (reported in Feb. What's Happening) was suspended.

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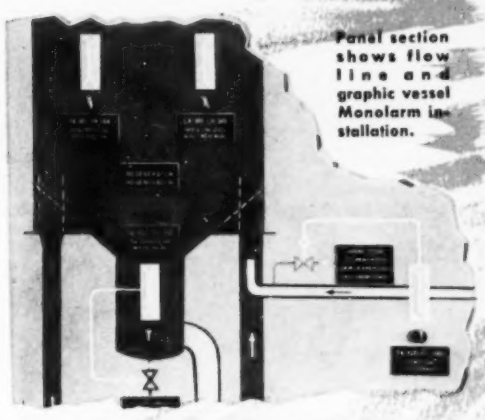
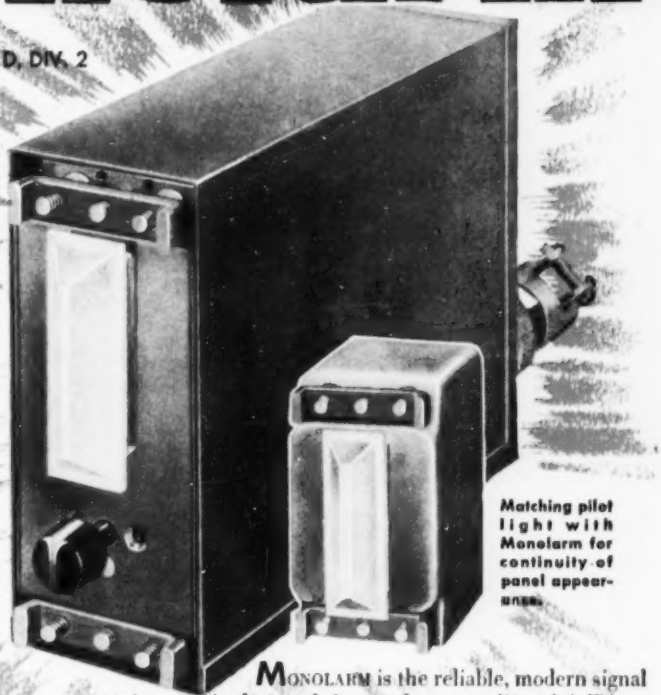


Panel section shows flow line and graphic vessel Monolarm installation.



Matching pilot light with Monolarm for continuity of panel appearance.

MONOLARM is the reliable, modern signal alarm unit designed for modern panelboards! Wherever instrumentation space is at a premium—wherever flow lines and graphic vessels must tell their visual processing story without interference from bulky signal alarms—this exclusive R & S development takes over with minimum space on front and back of panels.

Monolarm offers instant warning against any abnormality occurring in a processing operation at any time—and safeguards against expensive losses of production and materials. Should any abnormality occur, the normal light ceases to shine . . . the alarm light flashes rapidly on and off . . . also an external howler, if used, is sounded. Acknowledgment by the operator must be made by turning the re-set switch . . . the alarm light then assumes a steady state until the condition is remedied . . . then Monolarm automatically resumes its normal indication.

Several hundred highly successful installations are already completed. Monolarm is now available on your order.

Advantages of R&S MONOLARM

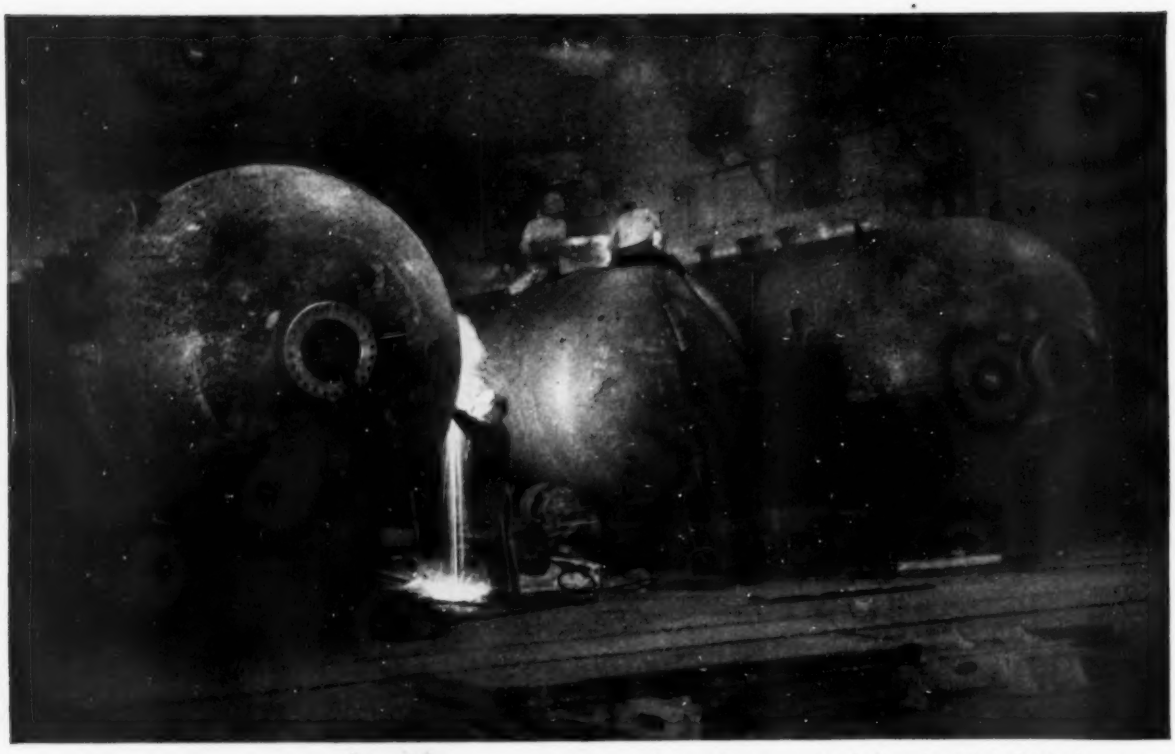
1. A single narrow bezel and button fits into a flow or graphic line diagram without interrupting the continuity of the design story.
2. Occupies minimum back-of-panel mounting space.
3. Lighting indications in two or three colors on *one* bezel.
4. Relamping is quick and easy from the front of the panel.
5. Instantaneous connect and disconnect of the power supply cable to Monolarm is provided by an interlocking switch receptacle and plug.
6. Maximum safety is afforded by interlocking the plug with the hermetically sealed switch, making it impossible to insert or withdraw plug under load. When the polarized plug is inserted into the receptacle and the plug shell is turned clockwise, it turns the switch to the "On" position and vice-versa.
7. Hermetically sealed plug-relays instantly removable if replacement is necessary.
8. Time delay circuit available to counteract turbulence and vibration when abnormal condition is reached.

• *Write for Sales Data Sheet #21253—52*

RUSSELL & STOLL COMPANY, INC. • 125 BARCLAY STREET, NEW YORK 7, N.Y.

RUSSELL & STOLL

PRECISION-BUILT ELECTRICAL EQUIPMENT—SINCE 1902



An excellent example of Graver's skill in fabricating pressure vessels is this 10′ x 32′ desalting tank for use in a new refinery unit now under construction. The tank was built for an operating pressure of 300 psi.

Something Special

IN PRESSURE VESSELS

The steady growth of the petroleum, petro-chemical and chemical industries has greatly increased the demand for specialized equipment, particularly new types of pressure vessels.

Graver's production facilities and skilled craftsmanship have provided the answer to pressure vessel problems for many years. Every Graver-built pressure vessel is fabricated in accordance with the ASME Code for unfired pressure vessels, the API-ASME Code as adapted to the special requirements of the petroleum industry, or to the even more stringent requirements set by customers. Complete X-raying, stress relieving and equipment for rigid inspection are additional features which assure that every fabrication will measure up to the requirements expected of it.

Whether fabricated in steels, clads or alloys, every pressure vessel bearing the Graver nameplate bears the symbol of quality.

GRAVER TANK & MFG. CO., INC.
EAST CHICAGO, INDIANA
NEW YORK • CHICAGO • PHILADELPHIA • DETROIT • WASHINGTON
CINCINNATI • CATASAUQUA, PA. • HOUSTON • SAND SPRINGS, OKLA.

GRAVER

(*To obtain more data on advertised products see page* 424)

Synthetic Liquid Fuel Industry Still Unlikely for a Good Many Years

THE need for a synthetic liquid fuel industry in this country is still in the distant future. . . Proposals by the Bureau of Mines for the manufacture of synthetic gasoline from coal and oil shale are definitely uneconomical under present conditions.

These facts, indicating the most likely trends in petroleum processing in the future, represent a summary of the conclusions reached by the nation's top oil industry authorities. They are from the final report by the National Petroleum Council's Committee on Synthetic Liquid Fuels Production Costs, released late last month.(1) Conclusions on costs via the various proposed routes are shown in the detailed summary in Table 1. They are:

Gasoline made from oil shale would cost the wholesale purchaser 14.7c/gal at the refining point. If made from coal by the Mines Bureau's Fischer-Tropsch process, it would be 29.4c/gal. And from proposed hydrogenation processes it would be at least 36.3c/gal.

There is some likelihood of further reducing the cost by continued research in oil shale and the Fischer-Tropsch coal method. But coal hydrogenation requires drastic improvements in existing methods, and such developments are not foreseen at this time. The possibilities of commercial operations in oil shale warrants continued attention by the petroleum industry, the NPC group stated.

NPC undertook the $500,000 study of the Bureau's design and cost data at the request of the Secretary of the Interior about 2½ years ago. The Bureau's Office of Synthetic Liquid Fuels has had appropriated for its development program over $74,000,000 since 1944. Much of this money has been spent on huge demonstration plants.

The Costs Committee of NPC pointed out that when the need does arise for synthetic gasoline, entirely new techniques, now unknown, may be available. Such methods can be developed from well designed pilot plants at a fraction of the cost of the big, expensive experimental units. —W.C.U.

(1) "Final Report of the National Petroleum Council's Committee on Synthetic Liquid Fuels Production Costs, Feb. 26, 1953." Chairman, W. S. S. Rodgers, The Texas Co. Available from NPC, 601 Commonwealth Bldg., 1625 K Street N.W., Washington 6, D. C. Telephone, EXecutive 3-5167.

More Gas Turbine Locomotives May Mean Bigger Residual Oil Market

RAILROAD men, locomotive builders, and the oil industry are watching with interest the increased use of gas turbine locomotives by Union Pacific Railroad. About three years ago UP put its first gas turbine job into service. A few weeks ago, UP ordered 25 more from General Electric at a total cost of $14 million. Six have already been delivered and are in freight runs. The balance are set for completion this year and next.(1)

Westinghouse has a model of somewhat different design (two turbines driving two generators where GE's has one big turbine running two generators) that has been tried out on a number of Midwest railroads. Test results have been released recently on two years operation on six roads, competing against diesels in freight and passenger service.

Advantages of the gas turbine are claimed as conspicuous in comparison to the diesel. The model GE is delivering to UP develops 4500 hp., equivalent to two units of a diesel electric.

More fuel is used in the turbine than in the diesel —but it's residual, so the ultimate fuel cost comes to about half that of a diesel. Also, virtually no lubricating oil is used—and that's an item making up 5% of a diesel's operating bill.

On the other hand, fuel supply poses a big "if?" makers and users agree. Residual oil is cheap and plentiful—but only near the source. Union Pacific

TABLE 1—Summary of Synthetic Liquid Fuels Production Costs

	—Fischer-Tropsch—		—— Coal Hydrogenation ——			—Oil Shale—	
			Modernized	—Conventional—			
	Single Plant	Single Plant	Single Plant	Single Plant	Multi-Plant(8)	Single Plant	Multi-Plant(5)
Coal or Shale:							
Tons per calendar day	7,040	17,200	11,690	12,960	112,500	76,800	384,000
Liquid Products: Barrels (42 gals.) per calendar day							
Gasoline	8,710	21,380	19,490	19,490	163,830	25,380	126,900
Diesel Fuel	.....	.....	.....	.....	.....	12,200	62,360
Gas Oil	1,710	4,210	.....	.....	.....	.....	.....
Liquefied Petroleum Gas	580	1,410	6,390	6,390	52,170	1,780	8,920
Residual Fuel	.....	.....	.....	.....	.....	340	3,050
Liquid Chemicals	.....	.....	1,120	1,120	.....	.....	.....
Total Liquid Products	11,000	27,000	27,000	27,000	216,000	39,700	201,230
Other Products:							
Coke: Tons/CD	.....	.....	.....	.....	.....	1,180	5,900
Fuel Gas (160 BTU/CF):							
Thousand Standard Cubic Feet/CD	.....	.....	.....	.....	.....	24,830	124,150
Ammonia: Tons/CD	.....	.....	.....	.....	.....	92	460
Sulfur: Tons/CD	190	466	.....	.....	.....	43	215
Manpower:							
Total men including administration	3,230	6,440	5,250	5,900	53,800	3,420	15,750
Construction Steel:							
Thousands Tons	89	177	196	220	1,710	178	694
Tons per daily barrel of total liquid production	8.1	6.6	7.3	8.1	7.9	4.5	3.5
Construction Labor:							
Million man hours	14	29	43	51	355	26	123
Investment Cost:							
Millions of dollars	184	380	477	533	4,074	333	1,518
Dollars per daily barrel of total liquid production	16,800	14,100	17,680	19,740	18,860	8,400	7,500
Cost of Gasoline with 6% Return on Investment after Income Tax:							
Cents per gallon	**35.7**	**29.4**	**36.3**	**41.4**	**43.5**	**16.2**	**14.7**

has no supply problem. In fact, most western roads would not. In the east, railroads would have to compete for a limited supply of residual, for which the steel industry has been a good and stable buyer. Bugs in the fuel problem may soon be licked though. Engine builders are working toward designs that can burn a wider range of residual fuels; and petroleum companies are working toward additives to make more fuels adaptable for the gas turbine.

Neither GE nor Westinghouse have given out details as to costs of maintenance; both say the engines must put more time in on regular runs before repair costs can be crystallized.

In the further future some authorities believe the eventual shift will be to powdered coal as the fuel. Coal is still the cheapest and most plentiful fuel railroads could use.

No matter what fuel, oil people are keeping their eyes on this newest development in the "iron horse" and its potential effects on petroleum market trends.

—W.C.U.

(1) "New Contender: Gas Turbines," *Business Week*, Jan. 10, 1953, p. 41.

Atomic Power Plant Plans Almost Assume Speed of Chain Reactions

THINGS move fast in atomic energy. Four months ago, experts in the field believed atomic power plants were in the relatively near future—five years hence.(1) Last month, even the most optimistic were surprised. Detroit Edison Co. said it may be ready to build such a plant within a year.(2)

The company is teamed with Dow Chemical Co. as one of five groups named by the Atomic Energy Commission to study this problem. The others are Monsanto Chemical Co. and Union Electric Co. of St. Louis; Pacific Gas & Electric Co. and Bechtel Corp.; Pioneer Service & Engineering Co. and Foster Wheeler Corp.; Commonwealth Edison Co. and Public Service Co. of Northern Illinois. They've each developed their own ideas, but the Detroit team is the first to say they're willing to start plant construction.

The unit would be built in metropolitan Detroit and feed power into existing electric lines. Company thinks the plant output will be competitive with power from other fuels. Design is planned for completion this year. Then the construction can start. The 1946 Atomic Energy Act forbids private construction or ownership of a nuclear reactor, but Congress is expected to relax some of these controls this year.

As of now, the reactor would be used to produce steam, which in turn will run a conventional turbine. Technical problems still thwart scientists' hope that electric power will eventually be made directly, sidestepping the expensive steam generation and turbine operations.

There seems little likelihood of the competitive spirit forcing one of the other AEC-chosen teams to build an atomic power plant any faster than Detroit Edison plans to. But it ought to be a good bet that the same spirit will bring out more such plans for earlier construction.

—W.C.U.

(1) "Atomic Power May Soon Become a Factor in Refinery Planning," PETROLEUM PROCESSING, October, 1952, pp. 1371-2.
(2) "Atomic Power for industry may be closer than you think . . ." *Business Week*, Jan. 17, 1953, p. 64.

Engineer Talking Motor Fuel Economy Is a Lone Voice

AT THE present time it seems the American public is not greatly concerned with gasoline economy . . . the avid desire of the European motorist for fuel economy seems to be lacking in his American counterpart," states a report recently prepared by three engineers of the Research Department of Ford Motor Co.(1) The current advertising of the large automobile manufacturers certainly does not bring forth anything to challenge their statement. Air conditioning, power steering, luxurious riding, advanced styling, intriguing names for new models have the spotlight, with little or nothing on gallons to the mile, or design features that achieve fuel economy.

However, the Ford technologists take the position that it is prudent to re-examine periodically the factors involving gasoline economy and to re-evaluate their relative improvement, for "the public demand can change with startling abruptness, prompted by economic or military restrictions."

Their studies were intended to show how economically our present engines can burn gasoline and to show some applications of fuel economy that the operator has to watch for. "It is intended to show a few points where the operator and engineer can still improve the present engine and secure fuel economy." The position is taken that radical changes will not come into effect, such as a small engine, or low axle ratios, and that our requirements that automobiles must accommodate six passengers in comfort rules against the small European type light car.

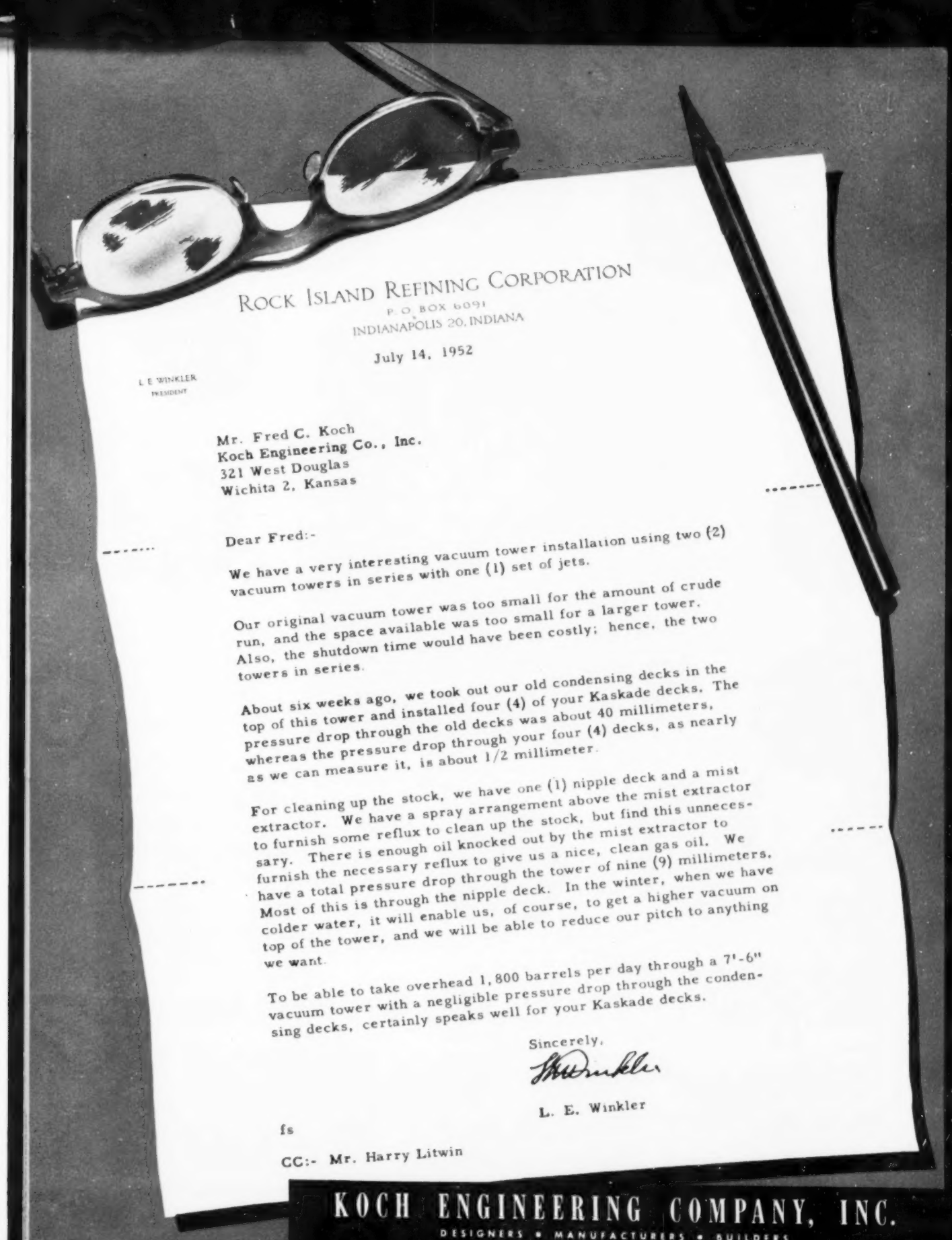
"Therefore, we must do everything possible to improve and squeeze the economy at all engine operating conditions," they state. "The most efficient engine we can produce will have the optimum compression ratio, as well as spark advance and fuel flow for greatest economy."

In order to investigate the driver's responsibility in fuel economy, a special fuel distance meter was developed in the Ford studies, in which the alternate filling and emptying of a bellows metered the fuel, while a fifth wheel measured the distance traveled. Through the use of this instrument, revealing data was developed as to the effect on gasoline mileage of the use of the choke, method of acceleration, the technique of the driver when approaching a light or point where it was known the car must come to a stop, pressure at which tires are held, and others. Their conclusion is that there is no one "gimmick" for achieving sensational fuel economy. Important savings can come about, however, with present engines through the attention of the automotive engineer and the car operator to many small details.

It is sound procedure for both oil and automotive companies to study how gasoline economy can be increased with the cars on the road, in the event an emergency calls for motor fuel rationing. Although the rationing of World War II was in part a means for conserving rubber, it is likely that another period of gasoline rationing will be solely for the purpose of conserving motor fuel.

—V.B.G.

(1) "Gasoline Mileage—Good, Bad and Indifferent," by H. S. White, O. Enoch and A. L. Haynes, Ford Motor Co., Engineering Research Dept.; paper presented before Metropolitan Section, Society of Automotive Engineers, New York, N. Y., Jan. 8, 1953.



ROCK ISLAND REFINING CORPORATION
P. O. BOX 6091
INDIANAPOLIS 20, INDIANA

July 14, 1952

L. E. WINKLER
PRESIDENT

Mr. Fred C. Koch
Koch Engineering Co., Inc.
321 West Douglas
Wichita 2, Kansas

Dear Fred:-

We have a very interesting vacuum tower installation using two (2) vacuum towers in series with one (1) set of jets.

Our original vacuum tower was too small for the amount of crude run, and the space available was too small for a larger tower. Also, the shutdown time would have been costly; hence, the two towers in series.

About six weeks ago, we took out our old condensing decks in the top of this tower and installed four (4) of your Kaskade decks. The pressure drop through the old decks was about 40 millimeters, whereas the pressure drop through your four (4) decks, as nearly as we can measure it, is about 1/2 millimeter.

For cleaning up the stock, we have one (1) nipple deck and a mist extractor. We have a spray arrangement above the mist extractor to furnish some reflux to clean up the stock, but find this unnecessary. There is enough oil knocked out by the mist extractor to furnish the necessary reflux to give us a nice, clean gas oil. We have a total pressure drop through the tower of nine (9) millimeters. Most of this is through the nipple deck. In the winter, when we have colder water, it will enable us, of course, to get a higher vacuum on top of the tower, and we will be able to reduce our pitch to anything we want.

To be able to take overhead 1,800 barrels per day through a 7'-6" vacuum tower with a negligible pressure drop through the condensing decks, certainly speaks well for your Kaskade decks.

Sincerely,

L. E. Winkler

fs

CC:- Mr. Harry Litwin

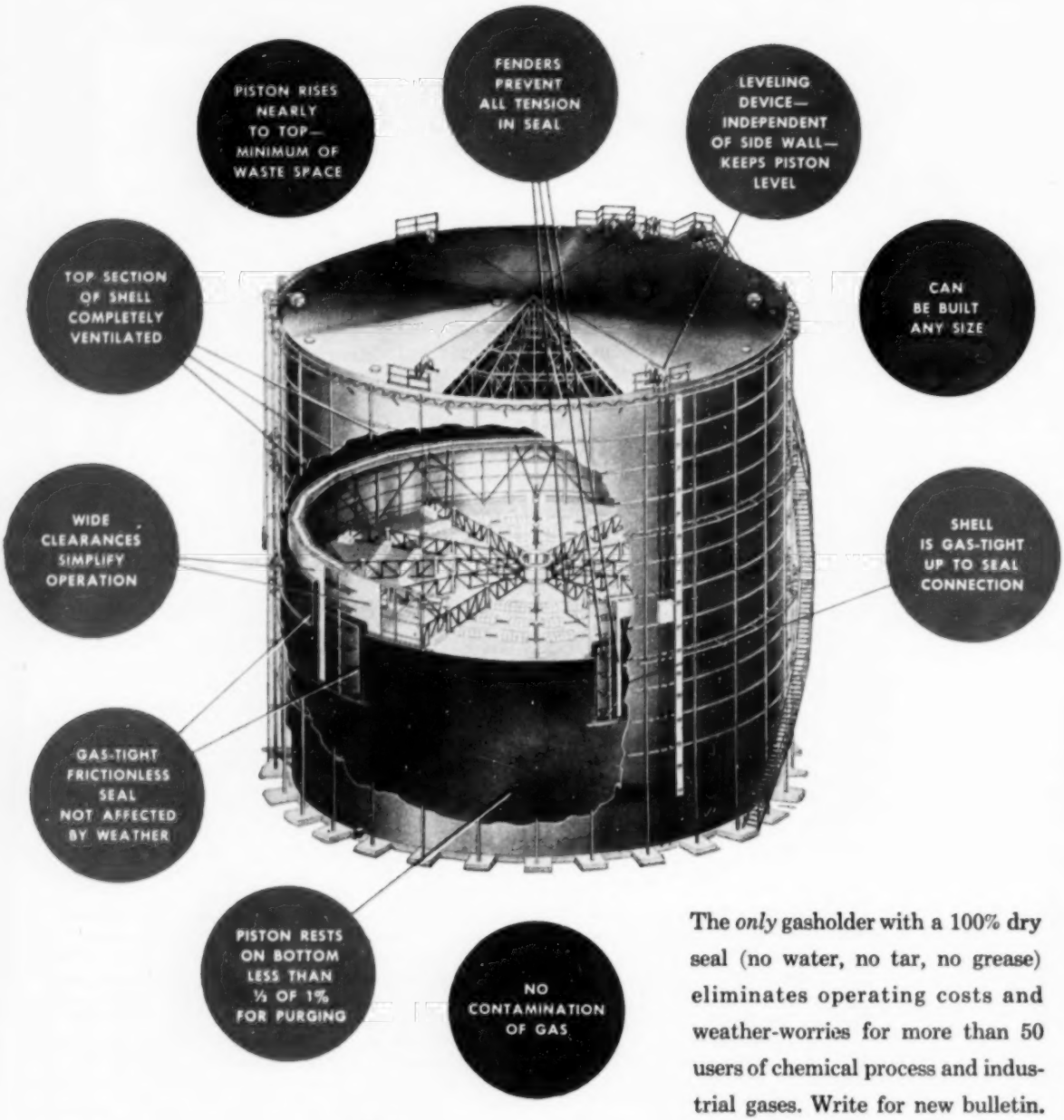
KOCH ENGINEERING COMPANY, INC.
DESIGNERS • MANUFACTURERS • BUILDERS
321 WEST DOUGLAS • WICHITA 2, KANSAS

Eastern and Export
30 Rockefeller Plaza
New York City

Pittsburgh, Pa., Repr.
D. D. Foster Co.
412 Peoples Gas Bldg.

Tulsa, Okla., Repr.
Myers-Bogwell Co.
Wright Bldg.

British Associates
Messrs. A. F. Craig & Co., Ltd.
Paisley, Scotland

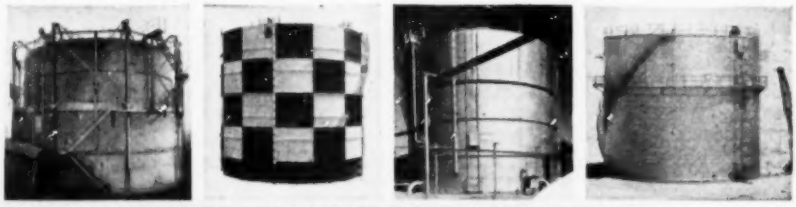

PISTON RISES NEARLY TO TOP—MINIMUM OF WASTE SPACE
FENDERS PREVENT ALL TENSION IN SEAL
LEVELING DEVICE—INDEPENDENT OF SIDE WALL—KEEPS PISTON LEVEL
TOP SECTION OF SHELL COMPLETELY VENTILATED
CAN BE BUILT ANY SIZE
WIDE CLEARANCES SIMPLIFY OPERATION
SHELL IS GAS-TIGHT UP TO SEAL CONNECTION
GAS-TIGHT FRICTIONLESS SEAL NOT AFFECTED BY WEATHER
PISTON RESTS ON BOTTOM LESS THAN ½ OF 1% FOR PURGING
NO CONTAMINATION OF GAS

The *only* gasholder with a 100% dry seal (no water, no tar, no grease) eliminates operating costs and weather-worries for more than 50 users of chemical process and industrial gases. Write for new bulletin.

Wiggins Gasholder by General American

CONVERSION EASY—OFTEN ADDS CAPACITY

Your old gasholder can be converted to a Wiggins type with all the Wiggins advantages.



WIGGINS VAPOR SEALS GENERAL AMERICAN TRADE MARK

GENERAL AMERICAN TRANSPORTATION CORPORATION
135 South La Salle Street • Chicago 90, Illinois
OFFICES IN PRINCIPAL CITIES
In Canada: Toronto IronWorks, Ltd., Toronto, Ontario

(*To obtain more data on advertised products see page* 424)

LONG HAUL... OR SHORT HAUL...

THERE'S A SANTOLUBE OIL ADDITIVE TO IMPROVE EVERY KIND OF ENGINE PERFORMANCE

Truck engines that pull heavy loads and run for long periods of time at high temperature . . .

Passenger car engines that pull light loads and run for short periods at low temperature . . .

For both these extremes of operation—as well as the full range in between—Monsanto makes a complete line of Santolube oil additives. They can be added to numerous base stocks and be custom-fitted to the kind of oil you produce. More important, these additives will help your oil fight corrosion, inhibit oxidation, keep engines clean, reduce engine wear.

Here are a few of the kinds of additives made by Monsanto:

- Pour point depressants
- Motor oil inhibitors
- Viscosity index improver
- Gear lubricant additives
- Motor oil detergents
- Corrosion inhibitor for distillate fuels
- Sludge inhibitor for domestic oil fuels
- Cutting oil additive
- Inhibitor detergent combinations for premium and heavy-duty service

Write for more information to MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 800 North Twelfth Blvd., St. Louis 1, Missouri.

Santolube: Reg. U. S. Pat. Off.

SANTOLUBE

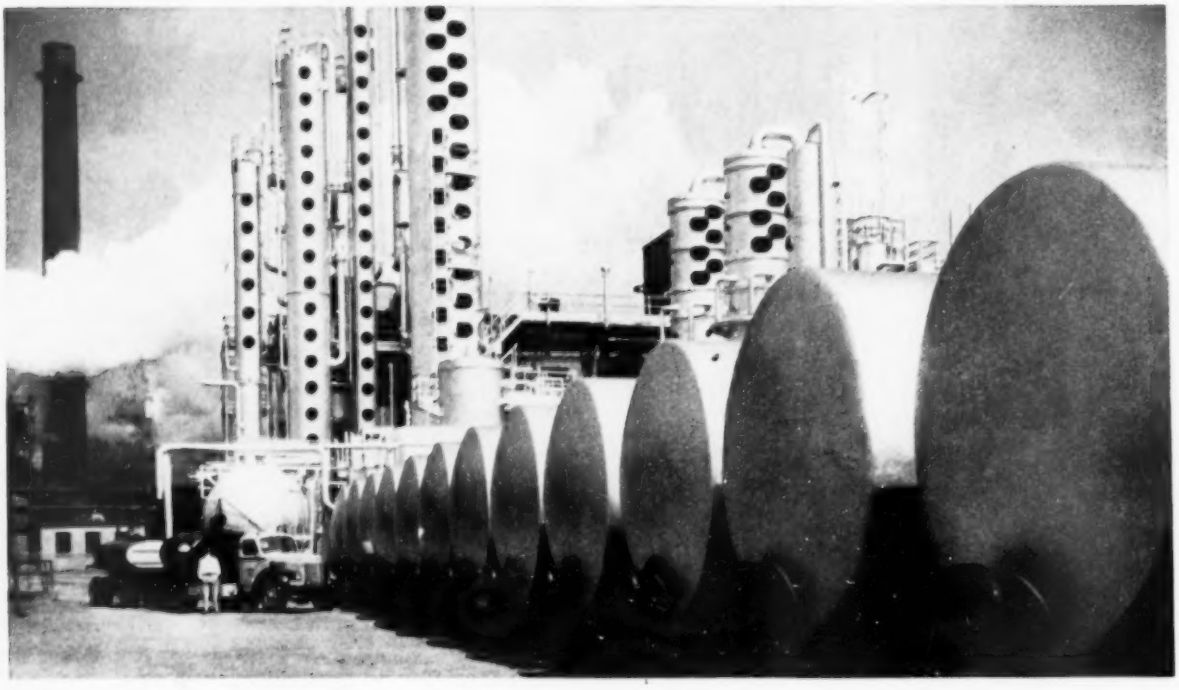
MONSANTO CHEMICALS – PLASTICS

SERVING INDUSTRY...WHICH SERVES MANKIND

(To obtain more data on advertised products see page 424)

TANKS PREPARED FOR ALCOHOL STORAGE BY CHEMICAL CLEANING

Dowell Service removed all traces of oil after mechanical cleaning method failed



Can you imagine cleaning out oil storage tanks so well that they could be used to store a product such as alcohol, which is so easily discolored by oil and grease?

That's exactly what Dowell did for a customer who wanted to convert three 350,000 gallon tanks from oil to alcohol storage.

Previous attempts to clean the tanks by sand blasting had not been satisfactory. And there was particular difficulty in cleaning behind the overlapping plates of one riveted tank.

Dowell Service did the job in about 10 hours per tank with this result: *the tanks were completely free from oil and grease.* Dowell furnished all trained personnel, chemical solvents, high pressure jets, pump trucks and controls.

Tank cleaning, including removal of paint from external surfaces, is just one of hundreds of applications for Dowell Service using chemicals for maintenance cleaning. For complete information and estimates on the cleaning of your equipment, call the nearest Dowell office, or write directly to Tulsa, Dept. C32.

DOWELL SERVICE

Over 100 Offices to Serve You with Chemical Cleaning for:

Boilers • Condensers • Heat Exchangers • Cooling Systems
Pipe Lines • Piping Systems • Gas Washers • Process Towers
Process Equipment • Evaporators • Filter Beds • Tanks

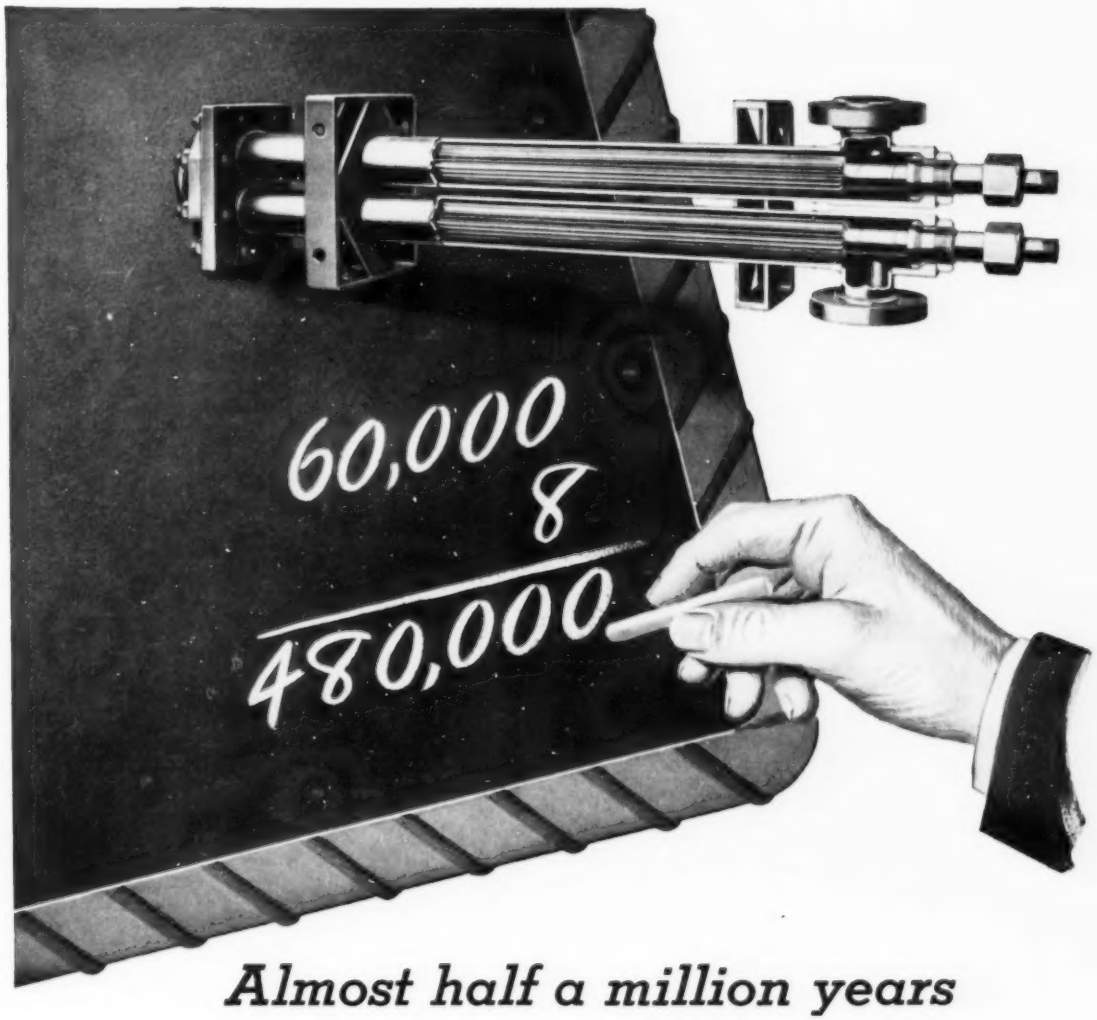
Chemical Services for Oil, Gas and Water Wells

DOWELL INCORPORATED • TULSA 1, OKLAHOMA

DOWELL

A Service Subsidiary of
THE DOW CHEMICAL COMPANY

(*To obtain more data on advertised products see page* 424)



Almost half a million years of heat exchanger service!

Multiply the number of installed G-R Twin G-Fin Sections by a conservative estimate for average length of service and that's the figure you get . . . almost half a million total years of service!

Some Twin G-Fin Sections have been in continuous use for more than 20 years. And no matter what the length of service or type of heat transfer duty, here is the uniform report of users . . . effective, durable, troublefree, economical.

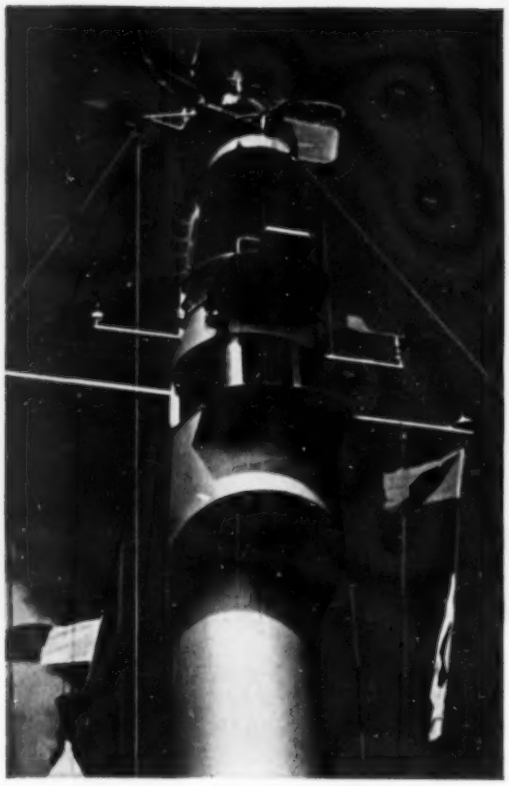
Twin G-Fin Sections can be used for a greater variety of services than any other design of heat transfer apparatus . . . that's one of their many advantages. Their installations include almost every type of heating, cooling, condensing, and heat exchange, and with many different liquids, gases and vapors.

Investigate the possibilities in your own plant for these time-proven standard interchangeable heat exchangers with the famous G-Fin elements. Write for bulletin, and ask about their applications to your heat transfer needs.

THE GRISCOM-RUSSELL CO., MASSILLON, OHIO

G-R HEAT TRANSFER APPARATUS *Twin G-Fin Section*

GR 280



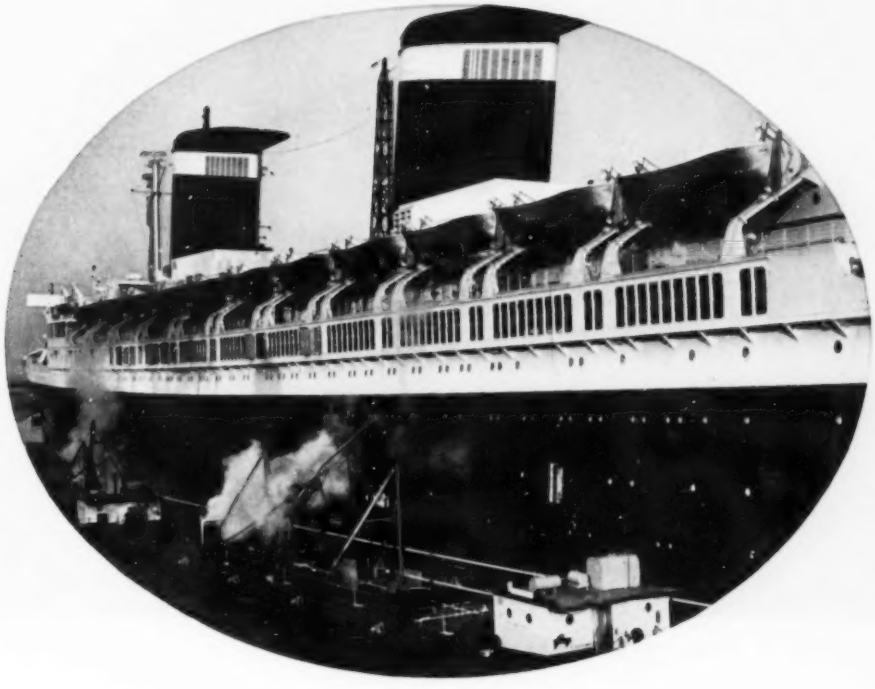
Dramatic radar tower of the S. S. United States. The ship was designed by Gibbs & Cox, Inc., built by Newport News Shipbuilding and Drydock Co., and is operated by U. S. Lines, Inc.

S. S. UNITED STATES MADE WITH BRICK!

Pumping her power aboard! Latent power, in the form of fuel. And the fuel oil that drives this magnificent greyhound of the seas would not exist but for brick.

Petroleum engineers responsible for the continued and efficient operation of equipment and furnaces in the great refineries of the world have come to depend on the GREFCO complete refractories service and quality products which flow constantly from 66 mines and modern manufacturing plants, here and overseas.

Whatever the furnace, whatever the equipment—from the smallest heater to the giant modern catalytic cracking units—you will find products of General Refractories Company being used. Products which are constantly being improved by research in the world's largest and best equipped laboratory. Products which are uniform in quality and which are manufactured under the closest supervision and controls. Products which assure maximum service.



Where service conditions indicate the use of high duty fireclay brick, well known and proven brands such as WYNN, ACME, BEECH CREEK, OLIVE HILL, SALINA and RANGER are available in standard and special sizes. If service calls for super duty fireclay brick, the quality brands of HIAC and SUPERAC are available. For the really tough conditions there are the several brands of high alumina brick, GREFCO SILLIMANITE brick and CARBEX silicon carbide.

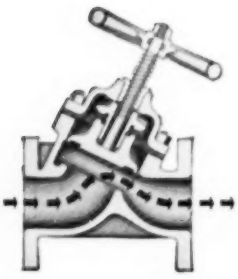
The selection of the proper mortar is of vital importance for maximum service of brick linings. Here again GREFCO has available just the correct type for each service condition. Such well known brands as BRIKLOK A, BRIKLOK B, KROMEBOND, SILLIMANITE, C-32, EVERHARD.

For the monolithic areas, the oil industry has come to depend on GREFCO castables. Proven brands such as BRIK-CAST, HIGH STRENGTH BRIK-CAST, SUPER BRIK-CAST, BRIK-CAST 3000, LITECAST, LITECAST 50, BASICRETE and BASICRETE 3100. Equally well known are the plastics—BRIKRAM and SUPER BRIKRAM.

GREFCO's staff of service research engineers are at your command to help solve your refractory problems. No obligation, of course. You can rely on their advice and counsel. Truly, GREFCO offers a *complete refractories service.*

GENERAL REFRACTORIES COMPANY
PHILADELPHIA

GENERAL REFRACTORIES



FOR SAFER CONTROL ⟶⟶⟶

Letters

Engine Wear Again

. . . You may be interested in the following comments which were made by a member of our Automotive Laboratory Staff:

"The article 'Friction—Main Cause of Engine Wear' covers quite well the original paper by Kunc, McArthur and Moody of Standard Oil Development Co.; however, the first paragraph states in part, as follows: 'On the other hand, the amount of work already done on corrosive wear has led to the development of crankcase oils for effectively reducing this type of engine wear.'

"This statement appears to be in conflict with statements by Kunc, McArthur and Moody, who point out in their paper that corrosive wear is not a problem in average field service. The lack of corrosive wear is not attributed by them to be related to a function of the lubricant. However, the evidence presented in the paper to support the theory that corrosive wear is not a field problem warrants considerable scrutiny. The condition used in the laboratory operating an engine at 60° F. is very severe, and undoubtedly the etched condition of compression rings brought about by such a condition would persist after considerable running under higher temperature operations.

"If less severe condition of operation were chosen, such as 120 or 130° F. where some corrosive wear might take place, the question then can be asked as to whether the typical pattern of corrosive ring wear would remain evident after long periods of operation under conditions of abrasive and friction wear."

H. Y. Hyde
Vice President
Tide Water Associated Oil Co.
Western Division
San Francisco, Calif.

• *Reader Hyde refers to the article based on the Kunc, McArthur, Moody paper which appeared in* PETROLEUM PROCESSING, *in the September,* 1952 *issue, pp.* 1263-1266. *Readers who are interested in this problem are urged to see also the article, "Role of Corrosion in Engine Wear," by J. C. Geniesse and H. R. Jackson, Atlantic Refining Co., which appeared in the November,* 1952, *issue, pp.* 1620-1622,

Conclusion of the latter paper was that "corrosion need no longer be a major factor in engine wear since it can be very markedly reduced through the proper selection of oil and/or by controlling jacket temperatures."

—Editors

Double Drainage Capacity with Clark DUO-STEP Traps

Engineers know that the effective drainage of condensate from steam lines is a matter of trap capacity. How much condensate can a steam trap of a given size drain in a specific time? The more it can drain the more efficient the trap.

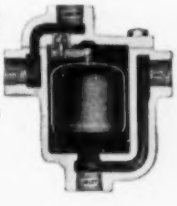
Many tests over a period of years prove that Clark Duo-Step Steam Traps, using the patented double fulcrum principle, can drain *twice* the condensate of ordinary traps.

So why not give Clark Duo-Step Traps a trial on your steam lines and discover for yourself their money-saving features. Phone, write or wire for information.

CLARK "701"-D (DUO-STEP) TRAP. A forged steel trap for pressures up to 500 P.S.I. and temperatures of 750°F. Equipped with "double-drainage" Duo-Step Leverage and Venting, Clark-loy seats and discs. Pipe sizes ½" or ¾".

SERIES "80"-D (DUO-STEP) TRAPS. Cast semi-steel construction for pressures up to 250 P.S.I. and temperatures to 450°F. Equipped with Duo-Step Leverage and Venting, Clark-loy seats and discs. Pipe sizes from ½" to 2".

"Y" SELF-CLEANING STRAINERS. Remove dirt, scale and grit from steam, fluid and gas lines. Sizes ½" to 3" I.P.S.



SERIES "60" INVERTED BUCKET TRAP. Choice of horizontal or vertical inlet or outlet. For pressures up to 150 P.S.I. "Clark-loy" guided disc and seat.

THE HOME OF DUO-STEP LEVERAGE

Clark

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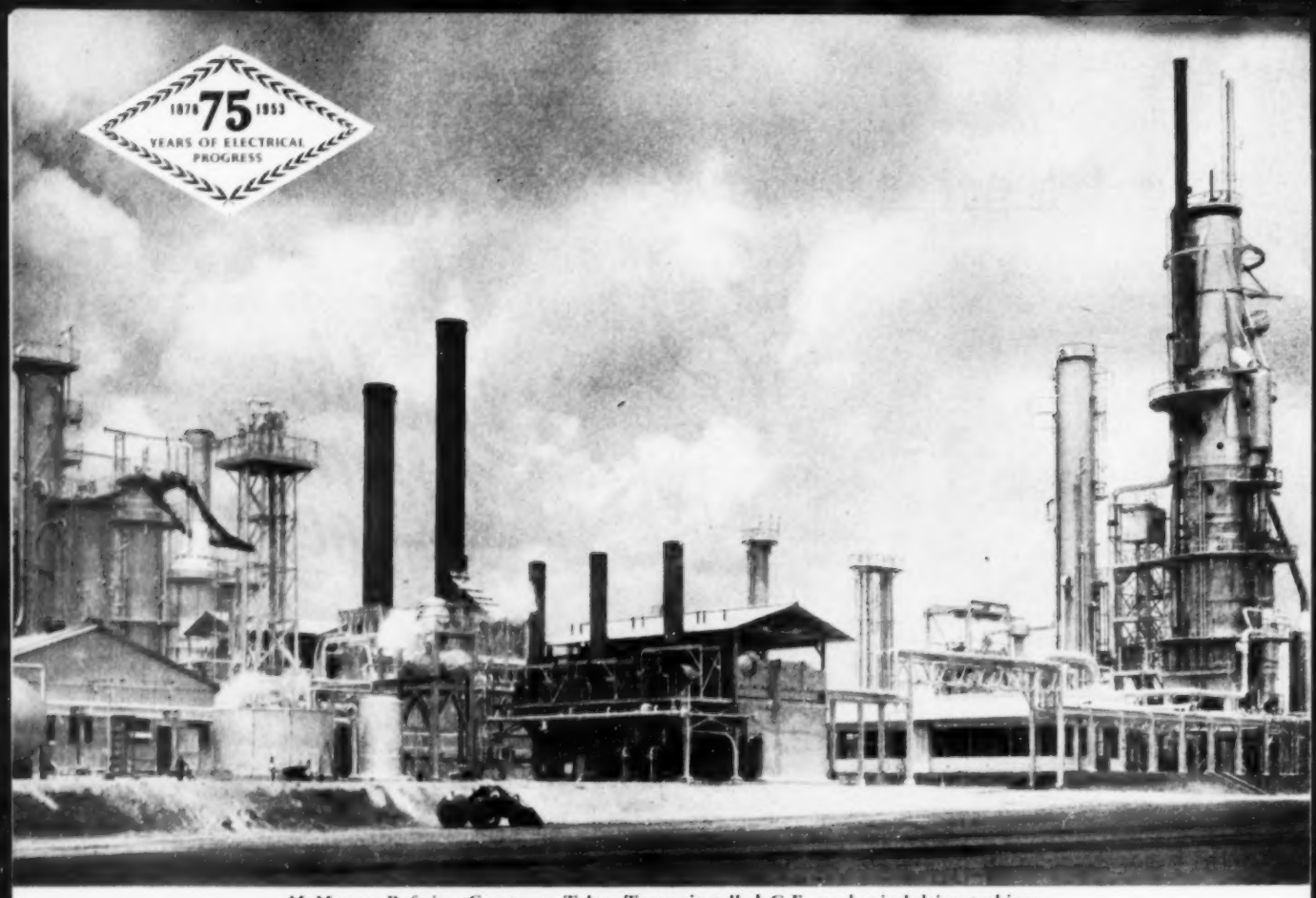
1830 EAST 38th STREET
CLEVELAND 14, OHIO

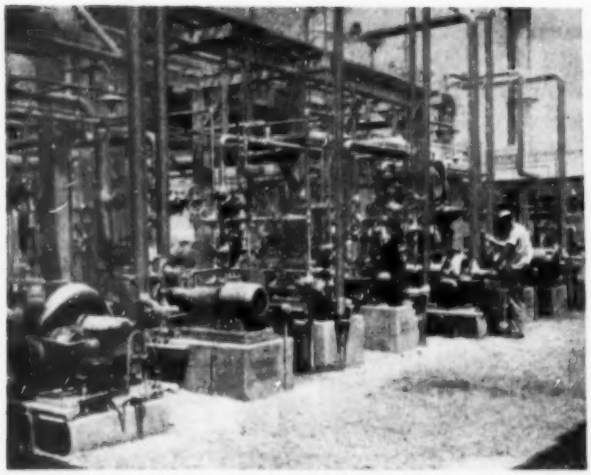
Distributors and Representatives in all major cities

(To obtain more data on advertised products see page 424)

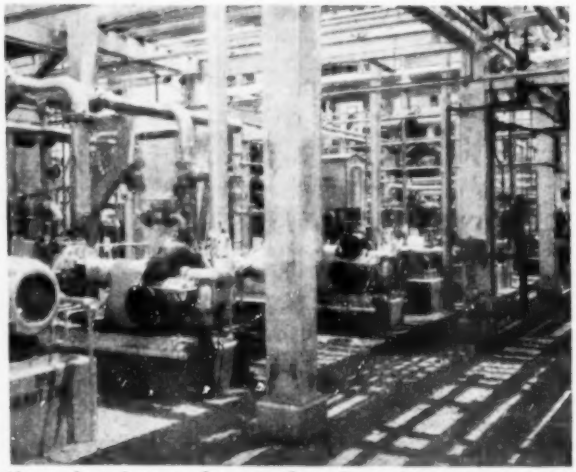


McMurrey Refining Company, Tyler, Texas, installed G-E mechanical-drive turbines throughout their plant to help assure continuous capacity output of 5000 bbls. per day.

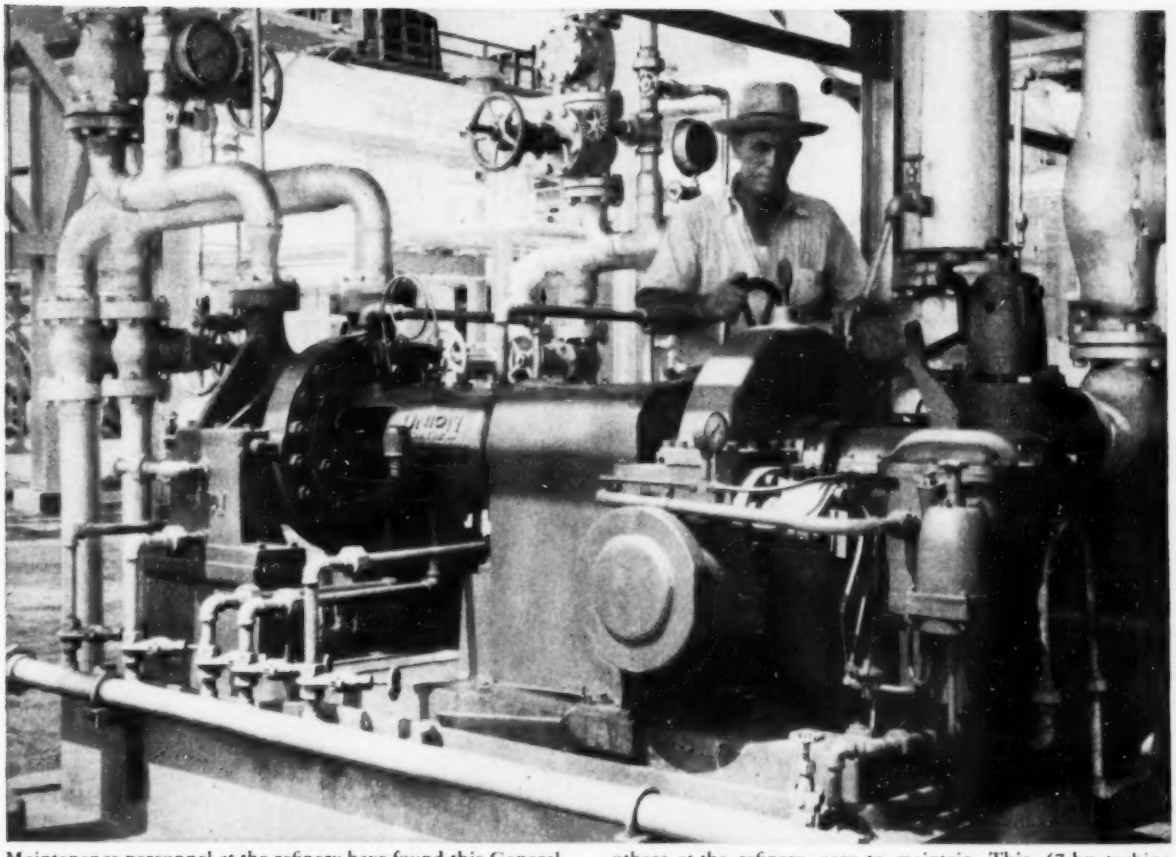
G-E Turbines Save Maintenance,



G-E turbines and motors are paired at McMurrey Refinery to utilize large steam supply efficiently. When process steam demands decrease, surplus steam is economically diverted to turbine drives. These Type DP turbines range from 8 hp to 41 hp.



Shown here is part of a row of ten General Electric Type DP turbine drives and motors, ranging from 9 hp to 48 hp. The many interchangeable parts on these turbines make stocking of spare parts an economical matter.



Maintenance personnel at the refinery have found this General Electric Type DP mechanical-drive turbine, like the many others at the refinery, easy to maintain. This 47-hp turbine at McMurrey Refinery drives a boiler-feed water pump.

Inventory Costs at McMurrey Refinery

Installed to improve steam balance, G-E standard turbines, with many interchangeable parts, also cut inventory costs.

The McMurrey Refinery, Tyler, Texas installed General Electric mechanical-drive turbines to help regulate steam balance. Since process steam demands range from 30% to 70% of available supply, surplus steam is economically diverted to turbine drives.

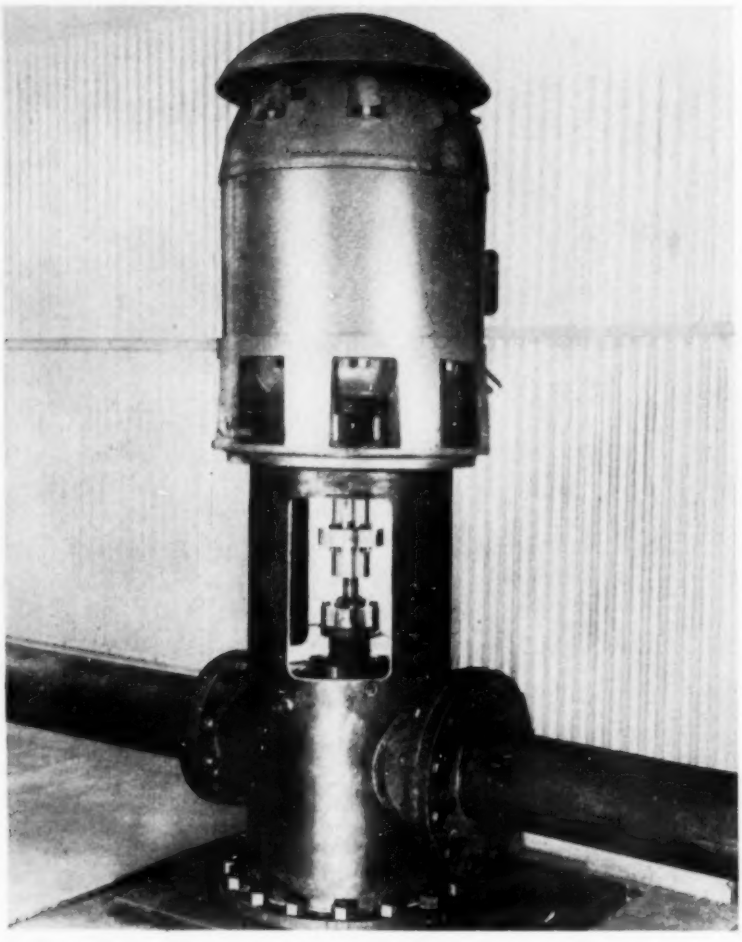
Time soon proved the many other advantages of G-E turbine drives which were especially designed for the petroleum industry. Mr. Dave Hood, Mechanical Maintenance Foreman at the refinery, states, "With these turbines on the line now for over a year, we're happy to report that they are extremely easy and economical to maintain, requiring very little of our time for maintenance."

Mr. Hood also said, "Since we have quite a few different sizes and ratings of turbines here, we're particularly pleased with the great number of interchangeable parts on these turbines. It certainly cuts down our inventory problem." Interchangeability of a great majority of the replaceable parts (regardless of hp rating) is a big feature with G-E standard turbine drives, which are paired with motors throughout the refinery to help assure uninterrupted service.

Call in your G-E sales-engineer or write for bulletin GEA-4955A, "A New Standard in Mechanical-drive Turbines." Section 252-58, General Electric Company, Schenectady 5, N. Y.

GENERAL ELECTRIC

In Large Refineries and Small...



JOHNSTON PUMPS ARE DOING TOUGH JOBS HANDLING VOLATILE FLUIDS

Here's a Johnston, installed in a large Southern California refinery, where it is used as a high-octane gasoline transfer pump. This unit, which has the pumping element enclosed in a sealed steel barrel, takes suction sufficiently above the pump bowls to give the required net positive suction head. The discharge is at the same level as the suction. Such a unit offers many advantages:

1. **The supply vessel can be located wherever convenient and the pump bowl is then set low enough for proper submergence.**
2. **Driver and piping connections are at the surface, eliminating dry sumps which are costly to build and expensive to maintain.**
3. **Nothing to lubricate but driver bearings.**
4. **Vertical design needs only ⅓ as much valuable floor space.**
5. **Due to diffuser type construction, this unit has higher efficiencies than conventional centrifugal pumps at high heads.**

This is another typical example of the ability of Johnston equipment to handle all types of pumping jobs. Why not let our trained engineering staff consult with you on the best solution to YOUR particular problem?

Send today for your free copy of the new bulletin "Vertical Pumps for Volatile Fluids." Ask for Bulletin B-33.

JOHNSTON VERTICAL PUMPS

JOHNSTON PUMP COMPANY

3272 EAST FOOTHILL BLVD., PASADENA 8, CALIFORNIA

(To obtain more data on advertised products see page 424)

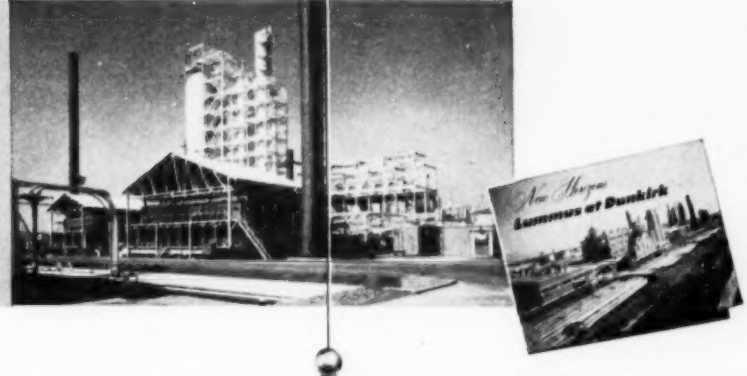
From barren beach to busy refinery

Here—at Dunkirk, France, once stood a petroleum refinery. History tells the rest. Under a rain of bombs in the dark days of 1940, a busy plant was reduced to rubble.

Lummus writes a big engineering & construction story at DUNKIRK

The same site today—occupied by the modern refinery of Société Générale des Huiles de Pétrole, an Anglo-Iranian Oil Co., Ltd. affiliate. The Lummus Company designed, engineered and built nearly all processing units. Correlation of effort enabled Lummus' New York and Paris offices to adhere to strict time schedules every step of the way. Lummus design in the lube oil section of the refinery provided such modern features as: a centralized heat source for the entire lube oil plant; one common control room for three major process units; a unique fluidized clay addition and metering system—all adding up to lower investment and operating costs, simplified operation and maintenance.

SGHP Dunkirk produces about 40,000 B/D of petroleum products ranging from bottled gas to pitch, including gasolines, solvents, fuel oils, lube oils, waxes and asphalts. This Lummus-designed-and-built Combination Atmospheric and Vacuum Distillation Unit processes about 80% of the refinery's intake of crude, producing 12 "cuts" ranging from LPG to asphalt.



Dunkirk is another example of the efficient assembly and use by Lummus of its world-wide facilities and experience. Have you discussed your petroleum, petrochemical or chemical expansion program with us? It may be profitable for you to do so.

"Lummus at Dunkirk"—latest in our popular series of brochures—tells a complete word-and-picture story of SGHP's new refinery. May we send you a personal copy? There's no obligation—just drop us a line at Room 359, 385 Madison Avenue, New York 17.

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DESIGNING ENGINEERS AND CONSTRUCTORS FOR THE PETROLEUM AND CHEMICAL INDUSTRIES

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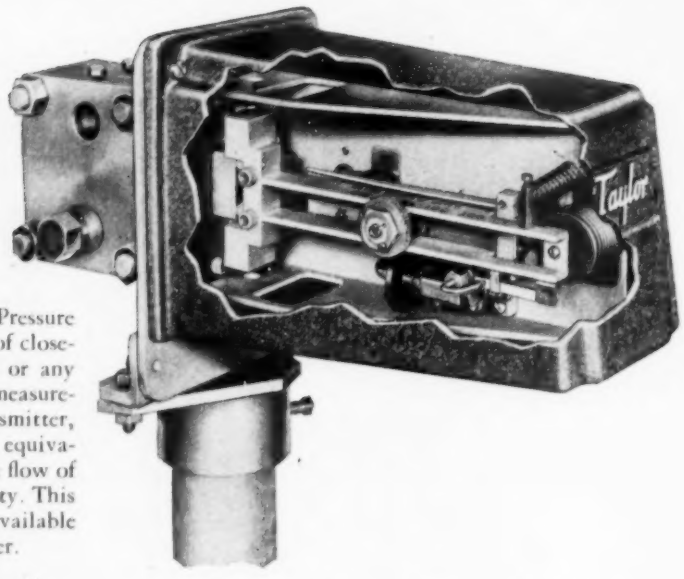
for . . . **WIDER USES**

SIMPLE INSTALLATION

EASY MAINTENANCE



THE new Taylor TRANSAIRE* Differential Pressure Transmitter is the answer to the problem of close-coupled fluid flow measurement, liquid level or any other installation requiring differential pressure measurement and transmission. It is a force-balance transmitter, designed to convert differential pressure into an equivalent 3 to 15 psi output. It can be used to measure flow of liquid, steam or gas; liquid level or specific gravity. This Transmitter has a 1500 psi pressure rating and is available in two ranges, 20"—200" and 80"—800" of water.

Inexpensive and Simple to Install

1. Simplified piping because it can be close-coupled to orifice flanges.
2. No Leveling—mercuryless dry meter.
3. Side, top or bottom bracket mounting available with 2" pipe stand.
4. No seal pots required—Negligible displacement because of force-balance construction.
5. Light weight for easy handling; weighs only 23 lbs.
6. Vent screws for simple, solid filling.

Economical—Easy to Maintain

7. Self draining or venting—no periodic manual venting or draining.
8. Mercuryless—flexible but tough Teflon coated glass fabric diaphragm.
9. Over-range to full body rating with no permanent damage.
10. Purges, if required, can be installed to keep body swept clean.
11. Simple range change by sliding pivot—screw driver trim.

Accurate

12. Relay valve for linearity, minimum hysteresis, fast speed of response.
13. Pressure effect 0.2% / 100 psi.
14. Temperature effect 1.0% / 100°F.
15. Self draining and venting. No errors build up during operation.
16. Hydraulic damping assures—stable air output even on vibrating pipe lines.

Rugged and Dependable

17. Body forged steel or types 430 and 316 Stainless Steel. Working pressure rating, 1500 psi.
18. Weather-proof housing built for tough service and outdoor mounting. Case is self-purging.
19. Force-balance construction—negligible motion—minimum possible wear.
20. Process sealing bellows 3-ply type 316 stainless steel.

Adaptable

21. 100% suppression—continuously adjustable from 0 to 100%. Ideal for liquid level applications.
22. Ten-to-one rangeability in each of 2 forms:
    a. 20-200" water, b. 80-800" water.
23. Side, top or bottom bracket mounting available.

Find out more about this latest addition to Taylor's three-part TRANSET* System. Ask your Taylor Field Engineer, or write for **Bulletin No. 98226.** Taylor Instrument Companies, Rochester, N.Y., and Toronto, Canada.

Instruments for indicating, recording and controlling temperature, pressure, flow, liquid level, speed, density, load and humidity.

*Reg. U. S. Pat. Off.

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ACCURACY FIRST
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Back of WOLVERINE PLAIN CONDENSER TUBES

[illegible] a long history of producing tube—nothing but quality—installed tube, if you please.

You can eliminate many tube failures by specifying Wolverine for your next retubing job or in your original installation.

Available in all popular sizes and a wide range of alloys.

Where highest efficiency must be crowded in smallest space —

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WOLVERINE TRUFIN*

—the integral finned tube

that will withstand vibration and extreme temperature changes. Available in wide range of sizes, fin spacings and heights.

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A PATENTED PROCESS RE. 22455

Wolverine Trufin and the Wolverine Spun End Process available in Canada through the Unifin Tube Co., London, Ontario.

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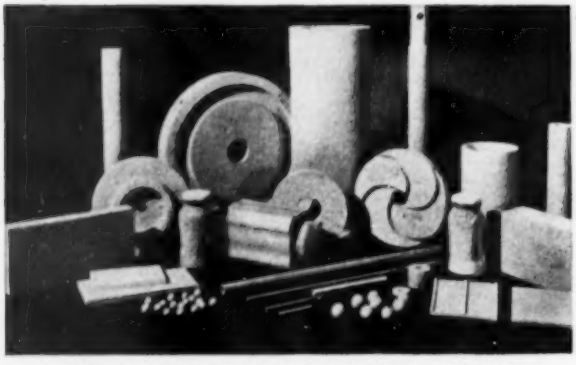
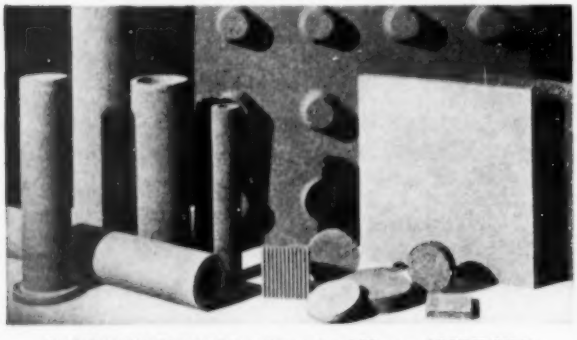


REFRACTORY SHAPES OF NORTON FUSED STABILIZED ZIRCONIA have made possible high temperature operations previously unattainable in the processing of hydrocarbons in the chemical industry. Processing temperatures have been lifted as high as 4700°F. No other refractory has so desirable chemical and electrical, and insulating properties. Write for Bulletin 1409.

CATALYST SUPPORTS are available in a variety of special refractory materials, structures, shapes and sizes. This variety meets the requirements of modern chemical processing. These supports lead to greater yield at lower cost. Write direct for Bulletin CS-2.



POROUS PLATES AND TUBES made of Norton ALUNDUM* fired to at least 2390°F are unaffected by acid and slightly alkaline conditions normally encountered. They combine uniform permeability with great strength. Write for Bulletin 140.

LABORATORY WARE is made of highly refractory Norton ALUNDUM mixtures which contain at least 85% fused alumina (up to 99% in special mixtures). It is not attacked by any organic solvent. Carried in stock by most laboratory supply houses. Write for Bulletin 793.

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HERE'S WHY ORBIT VALVES ARE ESPECIALLY SUITED FOR LPG SERVICE

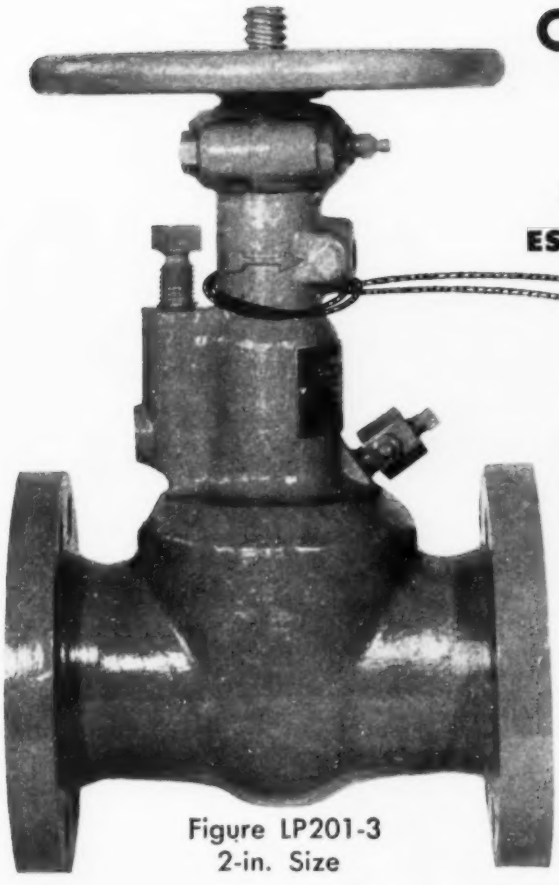

Figure LP201-3
2-in. Size

1. Forged Steel Body and Bonnet — Welded together to insure against vapor leaks.

2. Plastic Stem Packing that is adjustable. Stem Packing Chamber is backed up by a supply of auxiliary packing as extra insurance against leakage along the stem. Can be repacked under pressure in either open or closed position.

3. A Seating Principle that is both resilient and friction free, requires no lubricant to effect a seal or to wash out and contaminate the fluid being handled.

4. Rising Stem. Operator can tell at a glance whether valve is in open or closed position — guessing can be costly.

ORBIT Forged Steel LPG VALVES

are available in sizes: 1", 1½", 2", 2½", 3" and 4", ASA Ratings beginning at 150 lb., to and including 2500 lb. With Flanged and Screw Ends.

Maximum Rated Working Temperature of these valves is 250° Fahrenheit.

ORBIT Forged Steel VALVES are carried in stock by many supply stores.

® There is only <u>one</u> ORBIT

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(Servicing the Gulf Coast)

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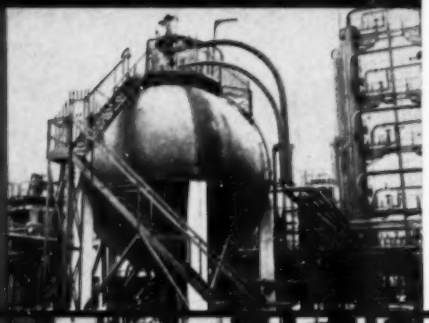
LEADING REFINERS RELY ON

PETRECO

ELECTRIC PROCESSING

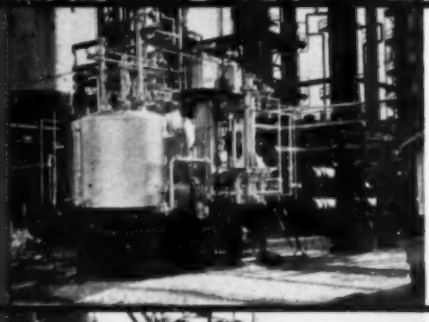
TO INCREASE REFINING EFFICIENCY

DESALTING



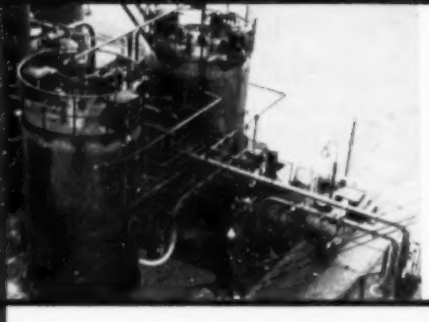
Petreco *Electric* Desalting eliminates salts, solids, and other impurities with such a high degree of efficiency that salt difficulties are eliminated – *enabling refiners to run more crude.*

DISTILLATE TREATING



Petreco *Electric* Distillate Treating takes the guesswork out of distillate treating. It is applicable to acid, alkali or doctor treating all distillate stocks. It permits continuous, automatically controlled treating with minimum equipment, handling and attention.

DESAPONIFICATION



Where caustic is added to crude prior to distillation, ash-forming materials resulting from such caustic are often present in fuel stocks. Petreco *Electric* Desaponification removes about 85% of such ash-forming constituents, enabling fuel stock to be marketed or used as a cracking charge.

For complete information, call or write

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PETRECO DIVISION

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ELECTRIC PETROLEUM PROCESSING

CRUDE OILS: REMOVAL OF SALTS, SOLIDS, OTHER IMPURITIES; DEHYDRATING

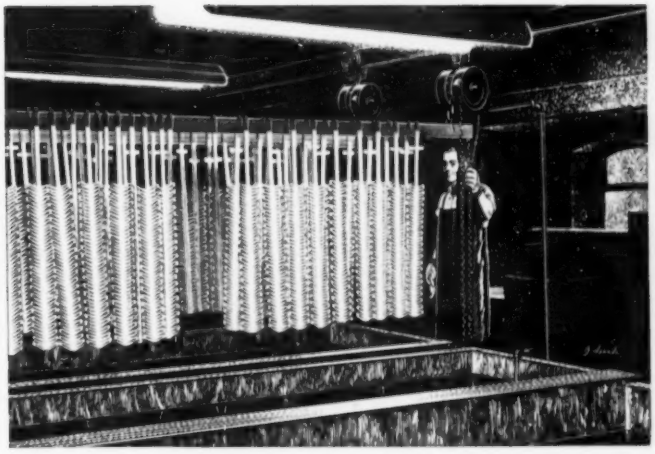
DISTILLATES: ACID TREATING; CAUSTIC TREATING; DOCTOR TREATING

FUEL OILS: DESAPONIFICATION, ASH REMOVAL

PC 53-1

Servel

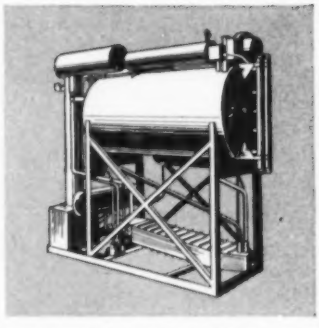
WELCOMES...and SOLVES



tough industrial cooling problems

When Colonial Alloys Company of Philadelphia decided to anodize aluminum products by the new and different Electrodizing Conservation or "EC" process, it faced the problem of maintaining proper temperature of the electrolytic bath solution.

To meet this essential requirement, Colonial Alloys chose a Servel 25-ton Water Chiller. Not only does this single Servel Air Conditioning unit maintain constant, controlled solution temperature, but it also provides office air conditioning, chilled water for experimental work, and cold drinking water.



The 25-ton Water Chiller used in the Servel installation at Colonial Alloys Company.

Colonial Alloys reports that the new "EC" process, in which Servel equipment plays such a leading part, has *increased aluminum anodizing production as much as five times, while cutting costs as much as 99%!*

This is one of many examples of how Servel Air Conditioning equipment benefits industry. Chances are, your problem can be solved in an equally satisfactory manner. Because Servel Air Conditioning *uses heat to produce cold*, operating economy is outstanding. It operates on gas, oil, steam or waste heat—whichever is the most economical fuel in your area. There are *no moving parts* to wear or cause vibration. And every Servel unit carries a complete *five-year warranty.*

★ ★ ★

Servel manufactures the world's finest air conditioning equipment to fit all air conditioning needs—residential, industrial, commercial—all-year or cooling alone. For complete information, clip and mail the coupon today.

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I want to know more about industrial uses of Servel Air Conditioning.

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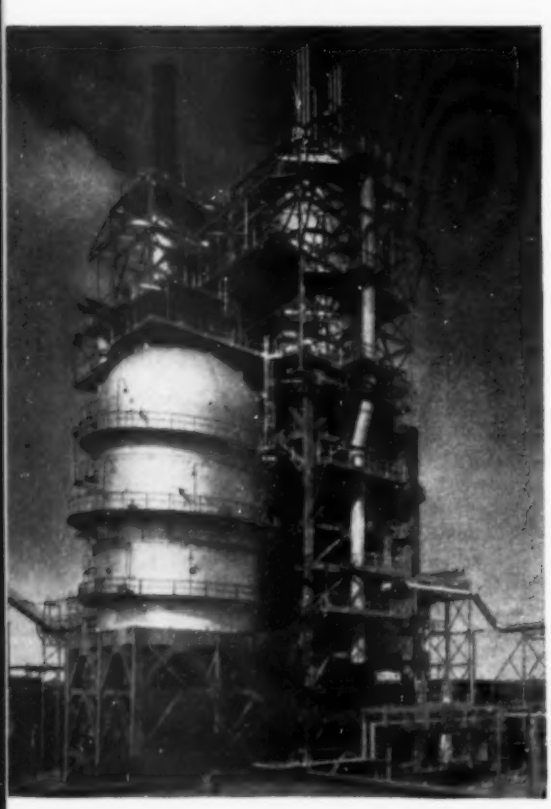
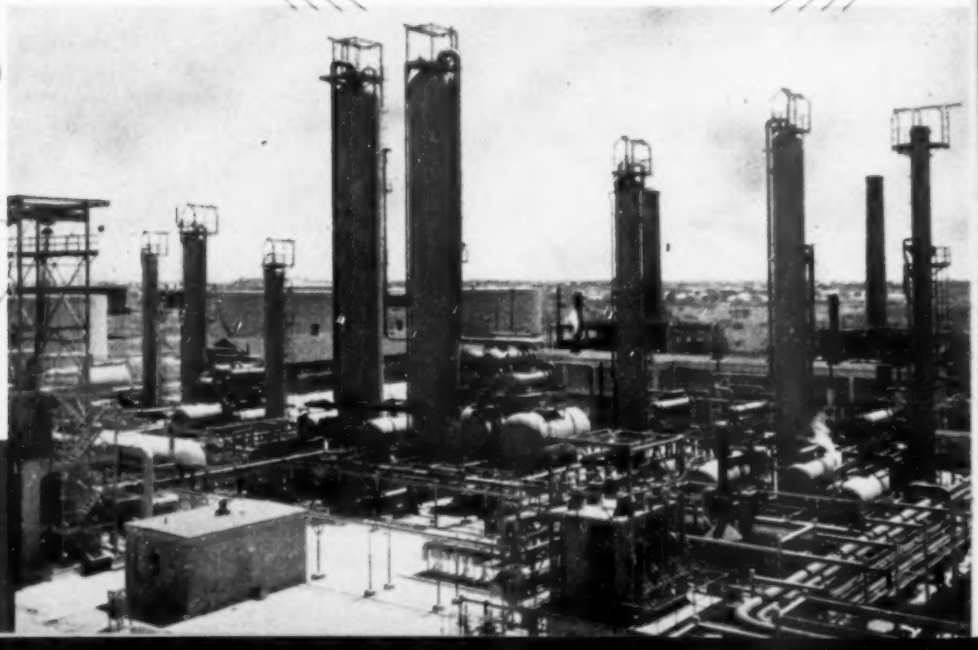
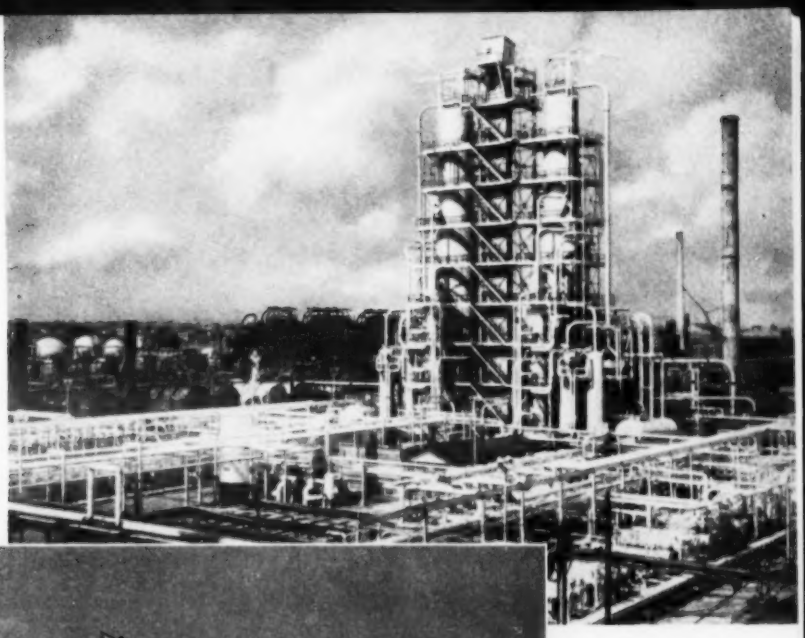
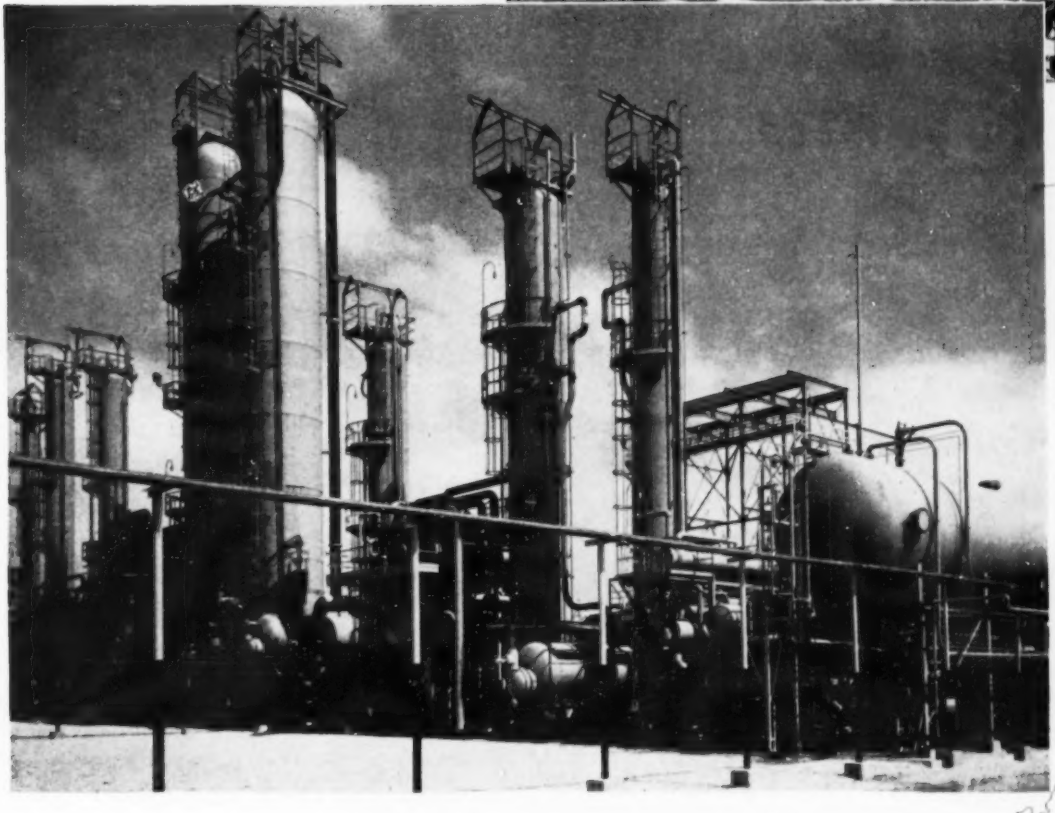


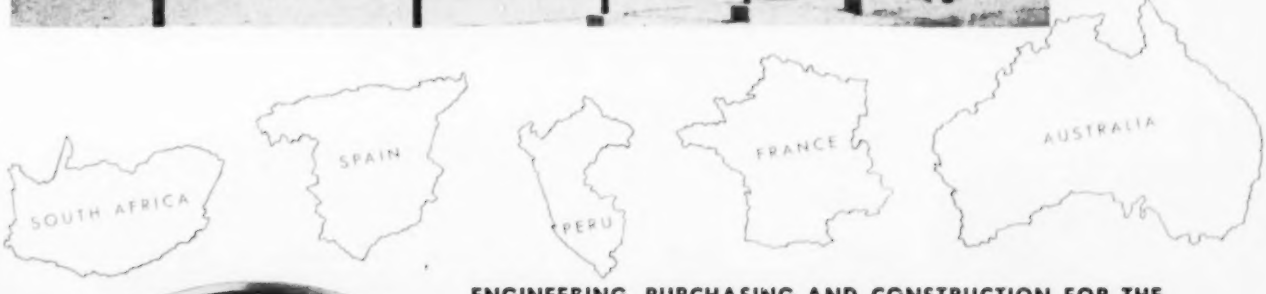
IN almost every country in the world and every state in the union where you find petroleum refining you'll find McKee engineering. Every year sees an increase in the number and size of projects designed and constructed by McKee . . . new names added to the list of countries in which McKee has executed contracts.

The reason for this steady growth lies in the excellence of McKee engineering, the soundness of McKee construction and the close coordination of these functions with expeditious purchasing services. That's why oil men from all over the world come to McKee again and again for *engineering that means assured results.*









ENGINEERING, PURCHASING AND CONSTRUCTION FOR THE PETROLEUM REFINING AND IRON AND STEEL INDUSTRIES

Arthur G. McKee & Company • Established 1905

Headquarters: McKee Building, 2300 Chester Avenue, Cleveland 1, Ohio.
Offices: New York • Tulsa, Oklahoma • Union, New Jersey • Washington, D. C.
British representatives of Metals Division: Head, Wrightson & Company, Ltd.
Canada: **Arthur G. McKee & Company of Canada, Ltd., 350 Bay St., Toronto 1, Ont.**

24 ACRES *Cover the World*

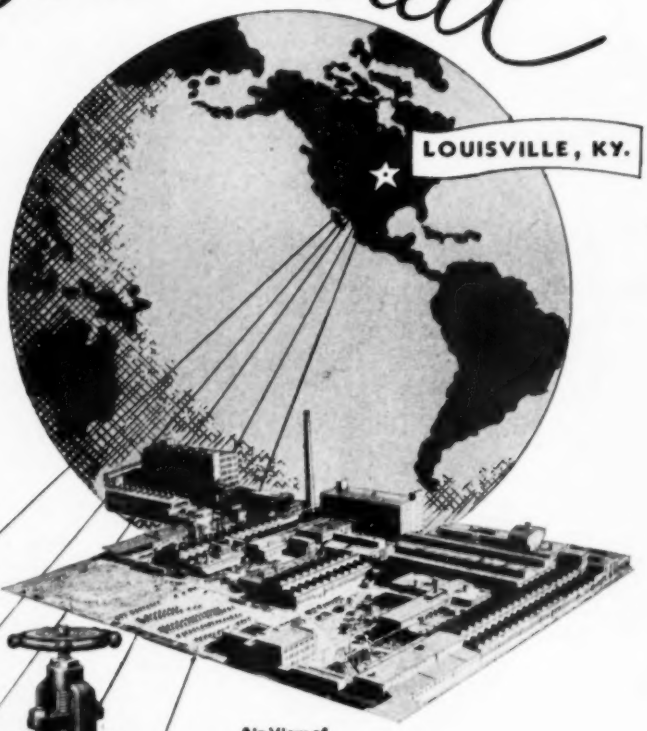
. . . with TOP QUALITY

DROP FORGED STEEL

VALVES, FITTINGS and FLANGES

by

Vogt



Air View of
Henry Vogt Machine Co.

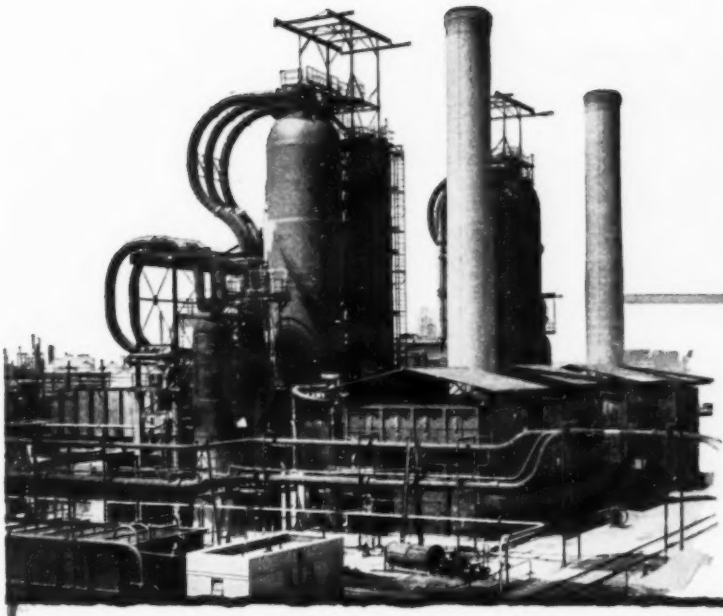
This 24 acre Vogt plant supplies the most comprehensive line of top quality *drop forged* steel piping materials anywhere available to industry. That's why they're the choice of leading refineries, power plants, chemical plants, etc., the world around!

OUR COMPLETE LINE INCLUDES

Flanged, Screwed and Socket Weld End Globe, Gate and Check Valves • Ells, Tees and Crosses • Couplings • Bushings • Plugs • Unions • Flanges and Flange Unions • Welding Heads

HENRY VOGT MACHINE CO. LOUISVILLE 10, KY.

Branch Offices: New York, Philadelphia, Chicago, Cleveland, St. Louis, Dallas, Charleston, W. Va.



Carey INSULATION is at work for GULF . . .

keeping process and steam lines operating at lowest cost

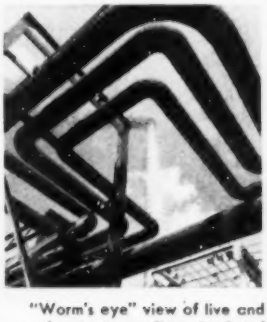
Refinery men demand *quality* insulation for processing operations. It's needed to keep fluids at constant temperatures. Helps cut fuel waste.

Since 1929, Carey insulation has been in continuous service at the Port Arthur, Texas plant of the Gulf Oil Corporation. Over the years, it has proven itself equal to the punishing strains of vibration and rapid expansion and contraction of equipment encountered in refinery operations . . . while guarding against heat loss, holding the line on costs!

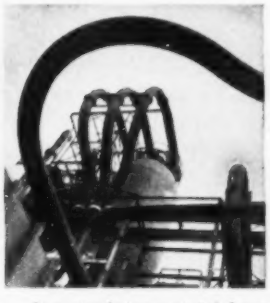
In *your* plant, you'll find dozens of applications where a Carey insulation material can conserve heat, save fuel. Carey's complete line of high and low temperature insulations includes blocks, blankets, pipe wrapping and jackets, cements and new Super-Light 85% magnesia in precision-sized blocks and nesting "O.D." pipe coverings that are easy and economical to apply.

Whether your problem is one of insulating "straight runs" or complicated shapes, a Carey Industrial Sales Engineer can show you why Carey insulation is best for the job. He'll gladly furnish you with complete technical and application data. No obligation to you. Telephone, wire or write our nearest office today.

Another Carey product—Careystone Corrugated Asbestos-Cement Roofing and Siding—protects Gulf Oil Corporation's warehouse at Port Arthur, Texas. This material is absolutely impervious to corrosion, rust, rot, decay; never requires painting or preservative treatment; virtually maintenance-free!



"Worm's eye" view of live and exhaust steam lines insulated with Carey materials. Besides the usual hazards of expansion, contraction and vibration, this Carey installation stands up under the extremely hot, humid weather of the Gulf area.



Carey insulation materials have weathered 23 years of continuous service on the fractionating tower and vapor lines of these atmospheric and vacuum stills at Gulf Oil Corporation's Port Arthur, Texas plant.

Write Today for Your FREE Copy

of "Industrial Insulation." Tells all about Carey insulations, and how to select and use them. A copy is yours for the asking.

***DEPT. PE-3**

FROM THE HOUSE OF CAREY—

Industrial Insulations • Careystone Corrugated Roofing and Siding • Built-up Roofing • Careyduct • Asphalt Plank • Asphalt Paints and Coatings • Industrial Flooring • Other Famous Products for Industry Since 1873

Carey

The Philip Carey Mfg. Company, Lockland, Cincinnati 15, Ohio • In Canada: The Philip Carey Co., Ltd., 277 Duke St., Montreal 3, P. Q.

TO PREVENT EVAPORATION LOSSES

Horton Pontoon Roof with a Horton Seal

A Horton Pontoon Floating Roof with a Horton Seal provides positive protection for petroleum products against boiling, filling and emptying, and standing storage evaporation losses. The entire bottom of a Horton Pontoon Roof is normally in contact with the liquid in the tank. There is no air-vapor space between the liquid and the roof.

Closing the space between the deck of the Horton Pontoon Roof and the shell of the tank is the Horton Seal. Vertical flexures every 22 inches allow the sealing ring to expand and contract enough to conform to the inside of the tank shell. Pantagraph hangers that support the sealing ring apply a gentle, even, outward pressure at all times . . . the sealing ring will ride over, yet conform to any irregularities in the tank shell with ease. A gas tight, weather-proof flexible fabric closes the space between the top of the sealing ring and deck of the floating roof to complete the seal.

The Horton Seal is so effective that the sealing ring can extend above the top of the tank shell and still maintain contact between its lower portion and the tank shell. Even in this extreme position it offers protection against evaporation losses.

Further information or quotations on Horton Floating Roofs and the Horton Seal may be obtained by writing our nearest office. There is no obligation on your part.

Top: 135,000-bbl. tank with Horton Pontoon Roof.
***Above:** Cutaway view showing operation of the Horton Seal.*

CHICAGO BRIDGE & IRON COMPANY

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY, and GREENVILLE, PENNSYLVANIA

Atlanta 3	2103 Healey Building	Detroit 26	1532 Lafayette Building	New York 6	2310—165 Broadway Building
Birmingham 1	1527 North Fiftieth Street	Havana	402 Abreu Building	Philadelphia 3	1630—1700 Walnut St. Building
Boston 10	1029—201 Devonshire Street	Houston 2	2130 C&I Life Building	San Francisco 4	1559—200 Bush Street
Chicago 4	2114 McCormick Building	Los Angeles 17	1526 General Petroleum Building	Seattle 1	1330 Henry Building
Cleveland 15	2215 Midland Building			Tulsa 3	1620 Hunt Building

REPRESENTATIVES AND LICENSEES

Horton Steel Works, Fort Erie, Ontario, Canada
Ateliers et Chantiers de la Seine Maritime, Paris, France
Constructions Metalliques de Provence, Arles-sur-Rhone, France
Chicago Bridge & Iron Company, Ltd., Apartado 1348 Caracas, Venezuela
Compagnia Tecnica Industrie Petroli, Rome, Italy
Whessoe Limited, Darlington, England
Motherwell Bridge & Engineering Company, Limited, Motherwell, Scotland
Comprimo, N. V., 21, Amstel, Amsterdam (c) Netherlands
Sociedade Chibridge de Construcoes Ltda., Av. Franklin Roosevelt, 194, Sala 704 C, Rio de Janeiro, Brazil

(To obtain more data on advertised products see page 424)

DU PONT
REG. U.S. PAT. OFF.

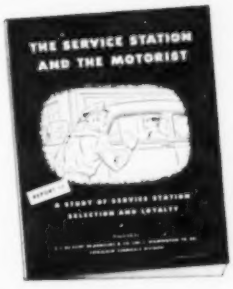
PETROLEUM CHEMICALS DIVISION

NEWS

DU PONT
REG. U.S. PAT. OFF.

March ★ One of a Series of Interest to the Petroleum Industry ★ 1953

Consumer Buying Trends Reported In New Booklet



The first report based on the Du Pont survey of service station customer buying habits is now off the press.

It is an authoritative study showing *why* motorists select certain service stations . . . and remain loyal to certain stations. As such, this report will be of considerable value to gasoline marketers in planning sales and promotion programs.

Copies are now being distributed to oil company marketing groups through the Du Pont Petroleum Chemicals Division district offices. Report No. 2 on brand name recognition and loyalty will be ready for distribution late in April.

To Guard Against the Effects of Copper Contamination — an "Insurance Policy"

Even when gasoline leaves the refinery entirely free of copper, it often ends up at the service station or in a customer's car with traces of copper present.

The trouble can generally be traced to the distribution system. All of these systems contain valves, pumps and various fittings which may be potential sources of copper contamination.

Today, consumer interest in gasoline quality is greater than it has been in many years. Your *at-the-pump* quality, therefore, can be an important competitive factor.

COSTS LESS THAN $2 PER 1,000 BARRELS

Refiners can be sure their gasolines are free from the harmful effects of copper contamination with Du Pont Metal Deactivator. The cost is less than $2 per 1,000 barrels.

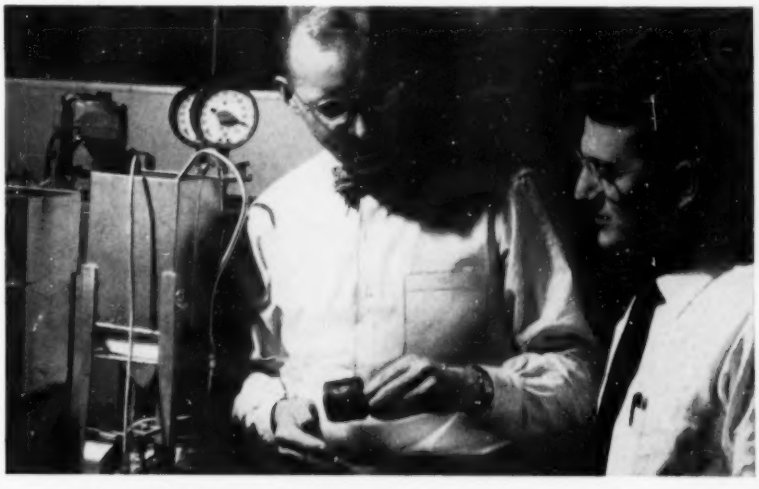
Du Pont Metal Deactivator is specially formulated to offset the effects of copper in gasoline. When copper is present—from any source—the desired stability can generally be obtained more economically with the aid of small amounts of Metal Deactivator rather than with antioxidants alone.

New Fuel Oil Additive Offers Many Advantages

Both dispersing and stabilizing properties combined in new additive developed by DU PONT

Many customer complaints on plugged filters, screens and fuel lines may now be eliminated through the use of a new additive.

Known as *Fuel Oil Additive No. 2*, it was developed by DU PONT as a dispersant and stabilizer for distillate fuel oils.



MANY CUSTOMER COMPLAINTS, caused by such conditions as this clogged oil burner filter screen, can be eliminated with Du Pont Fuel Oil Additive No. 2.

Distillate fuel oils tend to deteriorate during long-term storage. As a result, both soluble and insoluble residues are formed. The soluble residues are not particularly harmful. The insoluble ones, however, cause plugging of lines, screens and filters in the fuel systems of domestic oil burners and diesel engines.

The usual oxidation inhibitors used in gasoline, greases and lube oils have very little stabilizing effect on fuel oils. Although there are several methods of stabilizing distillate oils – such as clay filtration and caustic extraction—many of these oils have proved very difficult or expensive to stabilize.

ELIMINATES MANY COMPLAINTS

The new Du Pont Fuel Oil Additive No. 2 not only retards the formation of insoluble residues; but also reduces the particle size of those insoluble residues that are formed. In this way it practically eliminates the possibility of complaints due to clogging.

This makes it possible for a refiner to blend catalytic cracked stocks with

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

PETROLEUM CHEMICALS DIVISION
NEWS

CONTINUED

New Additive

his straight-run product without sacrificing stability in the blend.

SEASONAL FLEXIBILITY

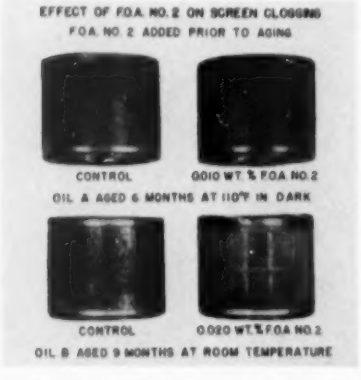
Marketing a blend of straight-run and catalytic cracked fuel oil has several advantages to the refiner such as:

1. Greater flexibility to meet peak seasonal demands.
2. Increased yield of domestic heating oils.
3. Release of straight-run stocks for sale as a premium diesel fuel or for use as charging stock.

Being ashless, Fuel Oil Additive No. 2 is particularly suitable for use in blended fuels for diesel engines.

HIGHLY EFFECTIVE

In all the types of fuels so far tested at the Du Pont Petroleum Laboratory, Fuel Oil Additive No. 2 gives desired results at a low cost because of its extremely high effectiveness.


EFFECT OF F.O.A. NO. 2 ON SCREEN CLOGGING
F.O.A. NO. 2 ADDED PRIOR TO AGING
CONTROL
0.010 WT. % F.O.A. NO. 2
OIL A AGED 6 MONTHS AT 110°F IN DARK
CONTROL
0.020 WT. % F.O.A. NO. 2
OIL B AGED 9 MONTHS AT ROOM TEMPERATURE

THIS PHOTO of four filter screens shows clearly the improvement in two oils to which Du Pont Fuel Oil Additive No. 2 has been added.

This new additive does not affect the color of the product in any way. It can be easily added—either directly from the drum or in a special kerosine solution to decrease viscosity.

SAMPLES AVAILABLE

Refiners who are interested in testing Du Pont Fuel Oil Additive No. 2 should get in touch with their local Du Pont Petroleum Chemicals Division representative for samples and full details.

Heads Central District Laboratory

Twenty years in petroleum research

DR. AUSTIN B. WILDER, laboratory manager in the Du Pont Petroleum Chemicals Division central district, has been engaged in petroleum research work for more than 20 years.

He joined Du Pont in 1947, after 14 years as a research chemist with the Pure Oil Company. Before this he was engaged in fuel research work for the General Motors Research Corporation in Detroit.

Dr. Wilder studied at Berea College. He received his B.S. and M.S. degrees in chemistry at Ohio State University and later received his Ph.D. degree in organic chemistry at the University of Chicago.

DR. AUSTIN B. WILDER

Fellowships to Advance Teaching of Chemistry Awarded by Du Pont

A new program to assist American colleges and universities in the teaching of chemistry will be begun by the Du Pont Company next fall. It provides for new fellowships or grants to 32 institutions during the next academic year.

The program includes two separate plans. Under one plan, grants have been made to 19 private colleges to help them maintain their outstanding performance in training students majoring in chemistry. The other provides postgraduate fellowships at 13 universities to improve the teaching of chemistry to undergraduates.

The need for such assistance was revealed in a comprehensive survey done by the company. Commenting on the new program, Crawford H. Greenewalt, president of the company, said, "The maintenance and encouragement of high-quality teaching is vital to the future supply of scientists and consequently research."

Decisions on detailed use of the funds are being left up to the institutions selected.

MOVIES AVAILABLE

Prints of the following Du Pont films are available to oil companies for training and public relations purposes. They may be borrowed or purchased. Address request to nearest Petroleum Chemicals Division district office.

Pipeline on Wheels—A 26-minute, full-color movie on tank truck safety. Suitable for both training and public relations purposes.

What Makes a Gasoline Good—An 18-minute cartoon movie in color. Presents the story of how high quality gasoline is made in easy-to-understand form. Ideal for dealer training meetings.

In addition to the above, Du Pont makes available a special library of films of particular interest to the petroleum industry.

DU PONT
REG. U.S. PAT. OFF.
Better Things for Better Living
. . . through Chemistry

Petroleum Chemicals

E. I. DU PONT DE NEMOURS & COMPANY (INC.)
Petroleum Chemicals Division • *Wilmington 98, Delaware*

District Offices: New York, N. Y. · Chicago, Ill. · Tulsa, Okla. · Houston, Texas · Los Angeles, Calif.

District Laboratories: Wilmington, Del. · Chicago, Ill. · Tulsa, Okla. · Houston, Texas · El Monte, Calif.

IN CANADA: Canadian Industries Limited — Toronto, Ontario — Montreal, Quebec — Calgary, Alberta

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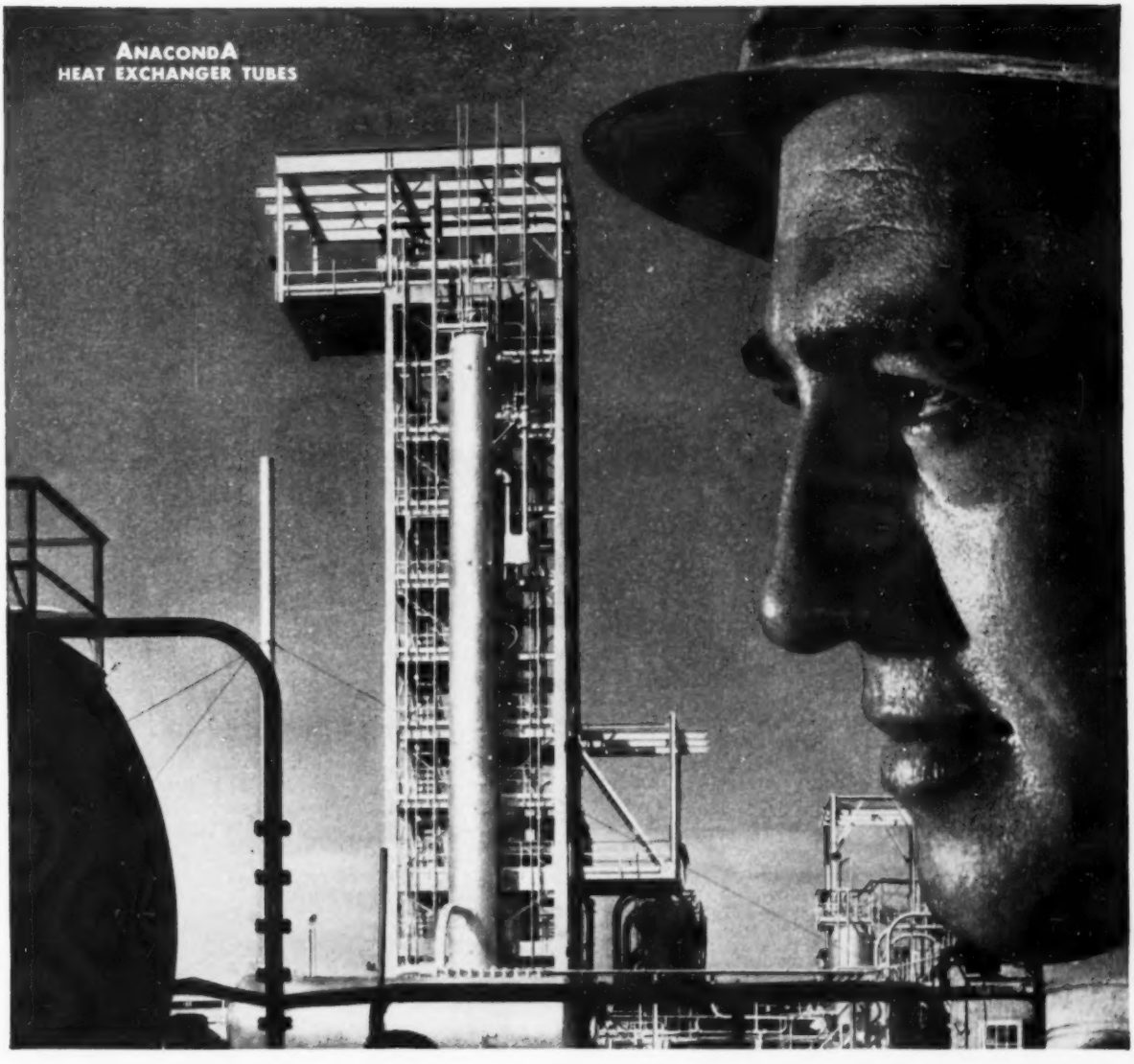
A-5053

Printed in U. S. A.



ARSENICAL ADMIRALTY-439:

OIL REFINER'S FAVORITE

WHERE oil refinery products handled by heat exchangers and condensers present no unusual problems of corrosion, high temperatures or high cooling water velocities, long experience indicates that tubes of Arsenical Admiralty-439 are the logical choice for satisfactory service life at economical cost.

This ANACONDA Tube Alloy offers good resistance to gas streams from both sweet and sour crudes and satisfactorily resists gases from sour crudes containing neutralizers. In addition, it is highly resistant to dezincification and, thus, can handle corrosive cooling waters at relatively high temperatures—a property which makes it definitely superior to non-arsenical Admiralty in most applications.

Whatever alloy best fits your operating conditions, choose it from the extensive line of ANACONDA Alloys for tubes and plate sheets. Our Technical Department's long experience in analyzing tube-performance problems is freely available to you. We have been working with copper and copper alloys for more than a century.

for efficient heat transfer

ANACONDA®
Heat Exchanger Tubes

The American Brass Company, Waterbury 20, Conn.
(In Canada: Anaconda American Brass, Ltd., New Toronto, Ontario)

Send me Publication B-2 "AnacondA Tubes and Plates for Condensers and Heat Exchangers"

NAME .....

COMPANY .....

STREET .....

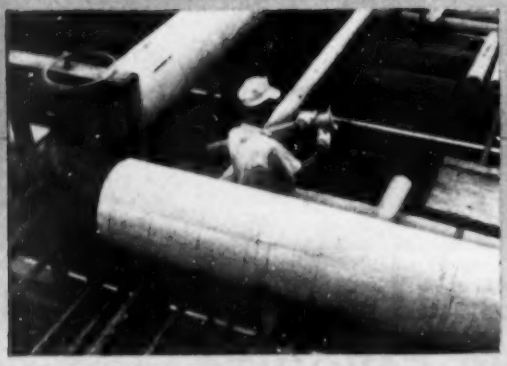
CITY ..... ZONE ..... STATE .....

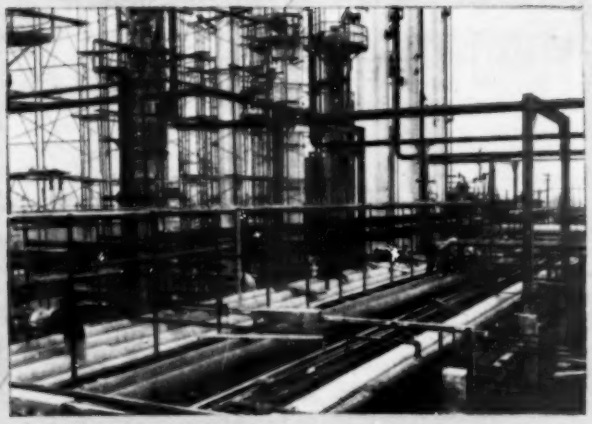
(To obtain more data on advertised products see page 424)

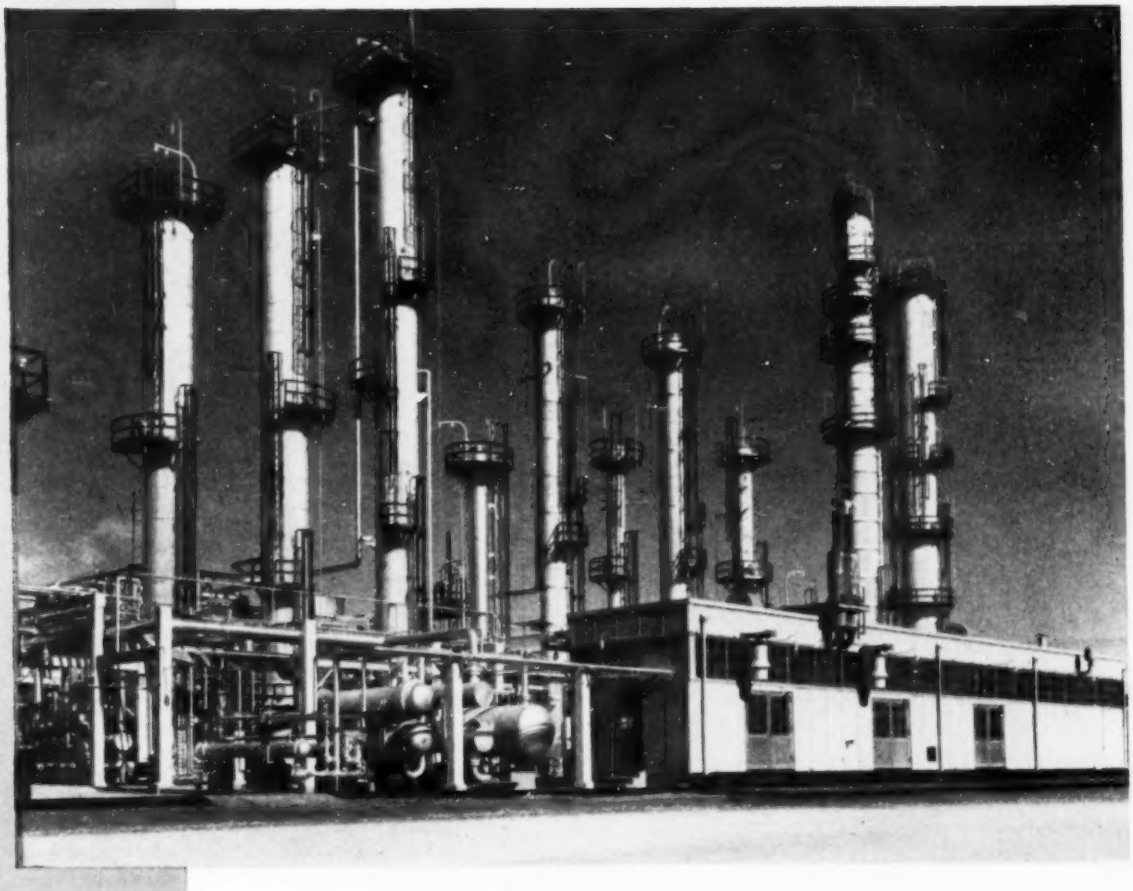
Cosden is first
to produce
all three aromatics
plus Platformate

with PLATFORMING-UDEX

facilities . . . built by PROCON







Completed by Procon in 11 months, the Platforming-Udex installation at the Big Spring, Texas, refinery of Cosden Petroleum Corporation is the **first** to produce all three aromatics — benzene, toluene, and xylene — plus a high octane motor fuel blending component.

Handling a charge of approximately 4500 barrels per day, the new facilities include a feed preparation section, a UOP Platforming Unit, a Udex unit, and a super-fractionation section. In addition, Procon also built accessory processing equipment, roadways, buildings, and utilities. All work was handled with maximum dispatch, and labor costs for the completed job were considerably below pre-construction estimates.

The successful and economical completion of this new plant is typical of Procon service on large and small construction projects for petroleum refiners throughout the world.

PROCON *Incorporated*

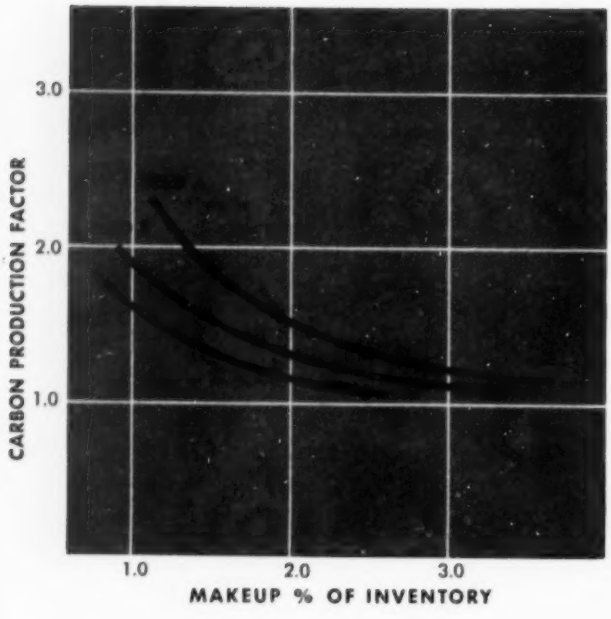
PROCESS CONSTRUCTION

1111 MT. PROSPECT ROAD, DES PLAINES, ILL., U. S. A.

IN ENGLAND

PROCON (*Great Britain*)
LIMITED

112 STRAND, LONDON, W. C. 2



Optimum Catalyst Selectivity For Your $$

MANY TYPES OF FEED STOCKS CONTROL CRACKING CATALYST SELECTIVITY, PARTICULARLY WHEN OBTAINED BY CUTTING DEEPER INTO CRUDES.

THE LOW COST FILTROL CATALYSTS GIVE BETTER SELECTIVITY PER DOLLAR EXPENDED. FOR EXAMPLE, WITH A CONTAMINATING FEED STOCK, CARBON PRODUCING FACTORS (CPF) FOR VARIOUS CATALYSTS PER $1000 PER DAY CATALYST EXPENSE ARE AS FOLLOWS:

UNIT CATALYST COST	TONS/$1000	CPF
$350/TON	2.86	2.0
$155/TON	6.35	1.4
$100/TON	10.0	1.2

AT CARBON BURNING LIMITATION EXTRA CAT CRACKER THROUGHPUT AVAILABLE BY REDUCING CPF IS:

CPF	**PERCENT INCREASE IN THROUGHPUT	APPROXIMATE EXTRA INCOME
2.0		
1.4	23.5	$ 9,000
1.2	36.5	$14,500

**Basis catalytic cracking operation at 30,000 B/D throughput.

OTHER REASONS FOR USING FILTROL CATALYSTS

1. Higher Octane Barrels
2. High Butylene Yields
3. Sulphur Resistant Catalysts
4. Faster Regeneration Rate
5. Low Attrition Rate
6. Technical Service
7. Uniformity
8. Lowered Excess Butane
9. Varied Plant Facilities

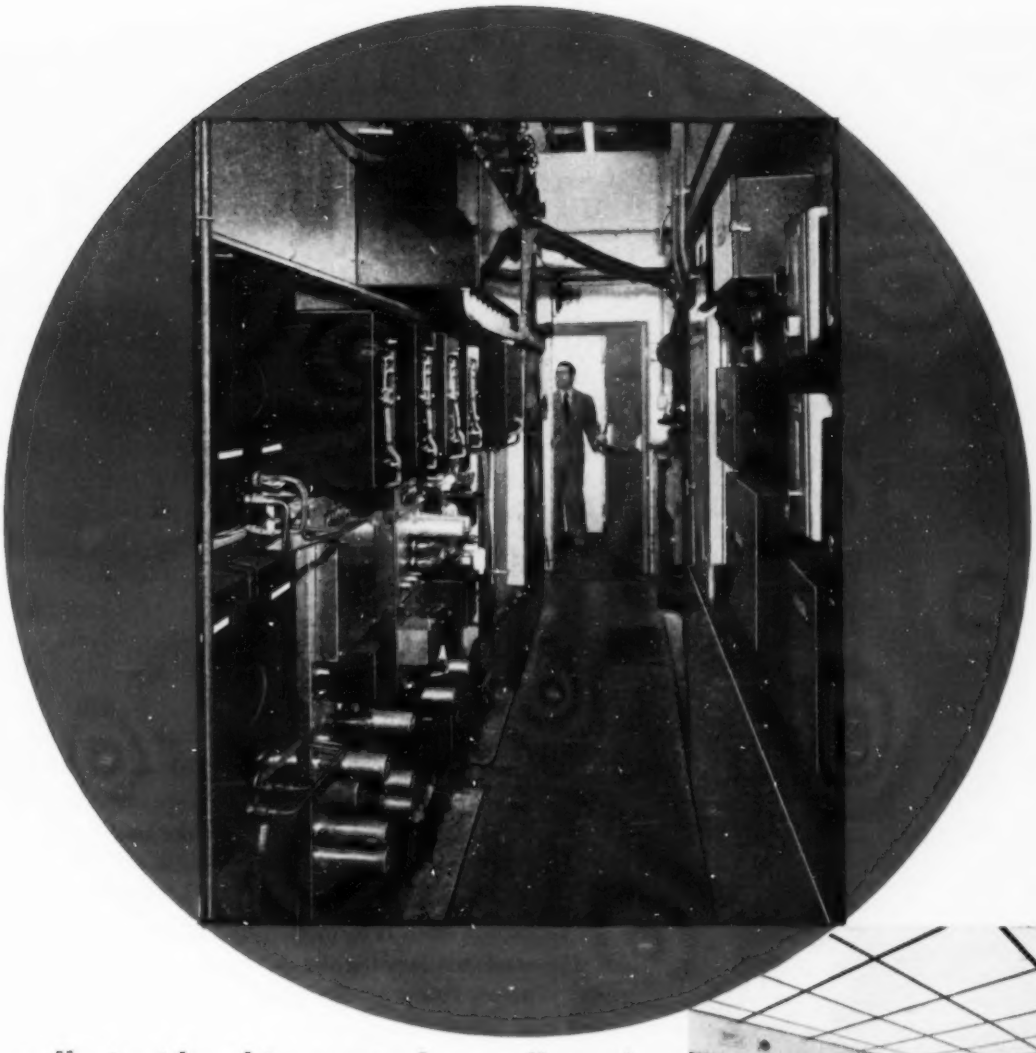
Filtrol*

FILTROL CORPORATION

OFFICES: 727 WEST SEVENTH STREET, LOS ANGELES 17, CALIFORNIA
PLANTS: VERNON, CALIF.; SALT LAKE CITY, UTAH; JACKSON, MISS.

CATALYSTS AND ADSORBENTS

*T. M. REG. U. S. PAT. OFF.



walk inside this control panelboard ...prefabricated by PANELLIT

You will find many new and unique features of engineering and construction in recently installed power station control systems . . . built by PANELLIT.

On every installation, excellence in fabrication and finish on the panel front is only exceeded by the ingenious behind-the-panel engineering for which PANELLIT is well-known. This engineering foresight assures the long-term serviceability of your entire control system. It will be recognized and appreciated for years to come by those responsible for maintenance and service.

PANELLIT maintains a separate Power Division with engineers specifically experienced in the design and installation of controls for the Power Industry. And, since PANELLIT is not an instrument manufacturer, it can be completely unbiased with respect to engineering assistance as well as the selection of controls for each phase of your system.

BRIEF FACTS ABOUT THIS INSTALLATION

Installation shown is the Central Control Room at the Edge Moor Station of the Delaware Power and Light Company, engineered and installed by United Engineers and Constructors, Inc., Philadelphia, Pa.

Prefabricated entirely by Panellit, Inc., the four-wall control panel forms the control room. An inner wall is the control panel front on which the instruments are mounted, the insulated outer wall serves as the outside wall of the control room and holds all contactors and electronic equipment associated with the combustion control.

LITERATURE WILL BE SENT UPON REQUEST.

PANELLIT, INC.

General Offices: 6312 North Broadway
Chicago 40, Illinois

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Stud-and-Nut Combination Resists Fatigue Failure

-------Stays on Job at HIGH Temperatures

For bolting applications involving high temperatures or high pressures, it pays to use the Bethlehem Continuous-Thread Stud, together with two Bethlehem Quenched Nuts.

This stud-and-nut combination is ideal for difficult bolting jobs because it resists the premature fatigue failure often induced by fluctuating temperatures and pressures. It's an economical combination, too, because of its long service life.

The Bethlehem Continuous-Thread Stud has no point of thread-runout. Therefore those stresses which could contribute to early failure are well distributed over the full working length of the stud, rather than being allowed to gather at any one point.

The Bethlehem Quenched Nut, made from .40 to .50 carbon steel, is formed by forging and extruding hot steel in a forming die. It is then quenched and tempered. This procedure makes the nut sufficiently strong to break virtually any stud or bolt on which it may be used. Like its companion stud, the Quenched Nut is furnished in a wide range of sizes.

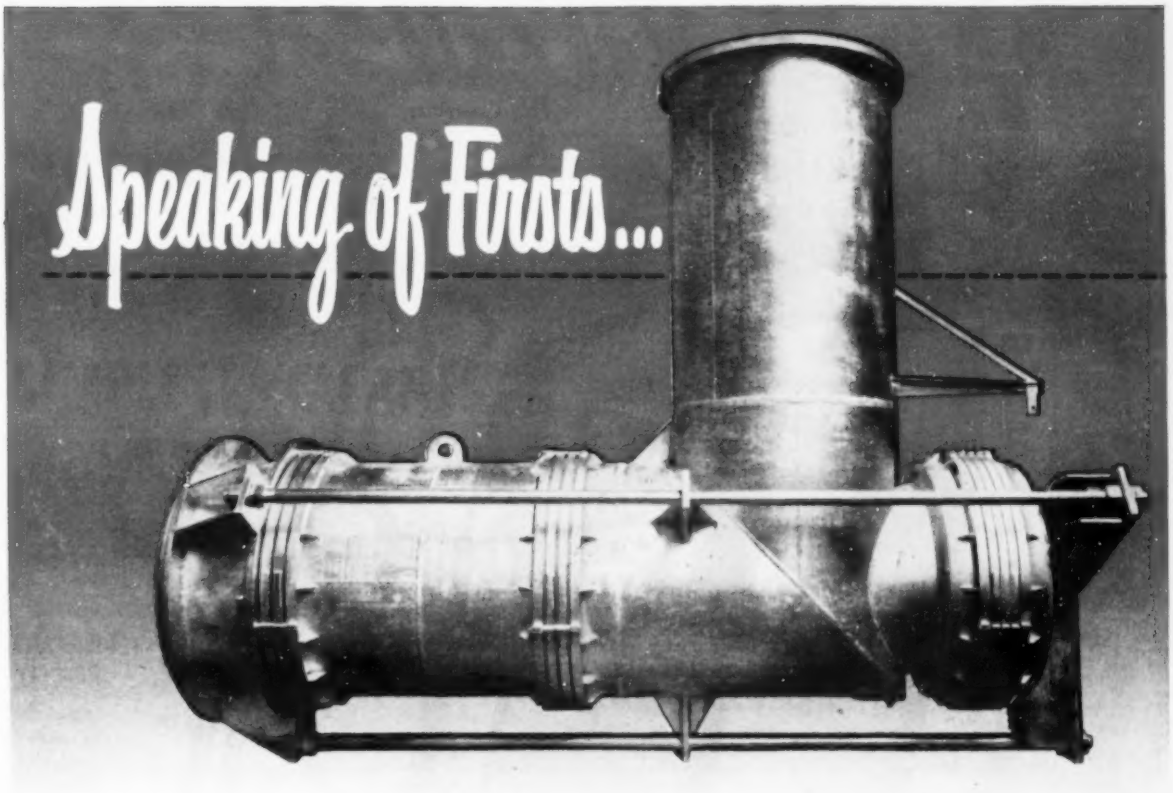
It will be well worth your while to consider Bethlehem Continuous-Thread Studs and Quenched Nuts for high-temperature bolting. The nearest Bethlehem office is at your service.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

Bethlehem supplies every type of Fastener



Recently, Zallea was given the assignment of developing a group of 48-inch expansion joints for flight propulsion test facilities on a classified defense project. The rigid technical specifications of this advanced application required "tailor-made" units for the job, so Zallea engineers analyzed the problem and designed the unusual-looking joint pictured above . . . the first of its kind. Actually, it is a Balanced Pressure, Universal Self-equalizing expansion joint, originally developed by Zallea engineers in 1945, operating at 165 psi and incorporating internal stainless steel turning vanes to provide a smooth flow of gases through the right angle bend. The unit absorbs 3" axial and 1.27" lateral movements through a temperature range from −100° F. to +650° F. No anchors are required since this arrangement neutralizes end thrust developed by internal pressures.

This example is representative of our ability to cope with the most difficult expansion joint problems. It is our business to specialize in the design and manufacture of one product only—expansion joints—and over the years we have learned how to solve the "tough ones" effectively and quickly.

Zallea Expansion Joints are available in diameters from 3 inches to 30 feet . . . for temperatures from sub-zero to 1600° F. . . . for pressures from vacuum to 300 psi in standard designs, and up to 2,000 psi in special designs.

The next time you are faced with an expansion problem, get in touch with us. We will be glad to survey your situation and recommend the most practical and economical solution. Zallea Brothers, 822 Locust Street, Wilmington 99, Delaware.

For detailed information on Zallea Expansion Joints and services write today for a free copy of Bulletin 351.

Zallea
EXPANSION JOINTS

WORLD'S LARGEST MANUFACTURERS OF EXPANSION JOINTS

(To obtain more data on advertised products see page 424)

NOW AVAILABLE

Rockwell

LUBRICANT TUBE KEY

Actual size of key supplied with each tube.

GUN LUBRICANT TUBE

Actual size of gun lubricant tube for Nordstrom valves.

BULK LUBRICANT TUBE

Actual size of bulk lubricant tube for Nordstrom valves.

IN TUBES!

FOR LUBRICANT SCREW AND LUBRICANT GUN USE

Lubricants For Nordstrom Valves

SIMPLEST, CLEANEST, MOST ECONOMICAL METHOD OF VALVE LUBRICATION

The new Rockwell lubricant tubes were developed to provide a better means of lubricating Nordstrom valves. They are a big time and money saver for maintenance departments; a great convenience to supply stores.

For Nordstrom valves equipped with lubricant screws, you just insert tube spout in the valve shank and turn key until lubricant chamber is filled. It's easy and quick! The lubricant is always kept fresh . . . no chance for contamination by dirt or grit. The inventory problem is simplified—one tube fits all sizes and types of Nordstrom valves.

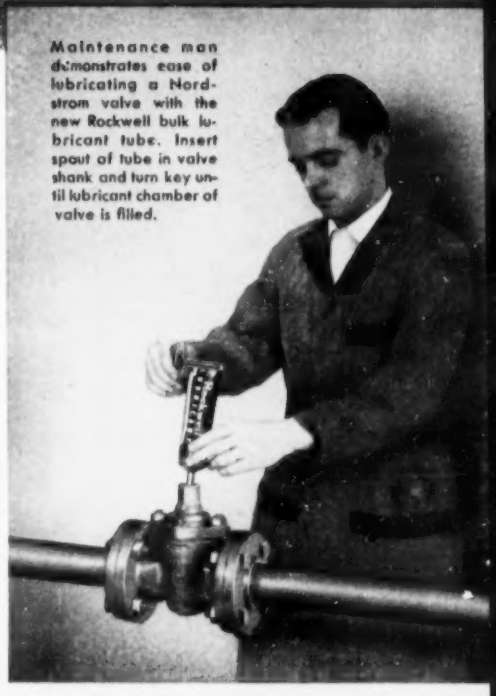
If you lubricate Nordstrom valves by lubricant gun, then specify the new Rockwell gun tube. Insert it in your gun and turn the key until all lubricant has been emptied into the barrel. The whole job takes only a few seconds.

Rockwell bulk lubricant tubes are normally packaged in boxes of four; however, single tubes are also available. Gun lubricant tubes are supplied in boxes of six.

The most commonly used Rockwell Nordcoseal lubricants are now produced in tube, stick and bulk form. Other Nordcoseal lubricants and Hypermatic, the energizable lubricant, will still be available in stick and bulk form.

To assure positive valve closure, quick easy operation and longest valve life, use *only* genuine Rockwell lubricants in Nordstrom valves.

Write for bulletin V-220 describing Rockwell lubricants for Nordstrom valves. Rockwell Manufacturing Company, Pittsburgh 8, Pennsylvania.



Maintenance man demonstrates ease of lubricating a Nordstrom valve with the new Rockwell bulk lubricant tube. Insert spout of tube in valve shank and turn key until lubricant chamber of valve is filled.

Demonstrating the convenience of filling a lubricant gun with the new Rockwell gun tube. Insert tube in gun and turn key until all lubricant has been emptied into the barrel.

ROCKWELL Built
Nordstrom Valves
Lubricant-Sealed for Positive Shut-Off

Another ROCKWELL Product

EYES OF THE PETROLEUM WORLD
will focus on TULSA, OKLAHOMA
May 14-23, 1953

INTERNATIONAL PETROLEUM EXPOSITION
TULSA MAY 14-23 1953

IPE HIGHLIGHTS for '53

- OVER 1200 COMPANIES EXHIBITING
- 26 ACRES OF EXHIBITS
- $100,000,000 VALUE
- ⅓ LARGER THAN EVER BEFORE
- HALL OF SCIENCE
- EQUIPMENT SHOWN IN OPERATION
- ATTENDANCE FROM 50 NATIONS

FOR THE

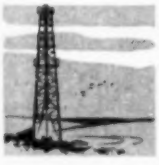
INTERNATIONAL PETROLEUM EXPOSITION

SHOW PLACE OF INDUSTRIAL MIRACLES

1948 - 1953! The truly Golden Age of Science and Engineering — era of atomic energy, jet propulsion, electronics, television — AND THE RICHEST PERIOD OF PETROLEUM PROGRESS! At the I.P.E., five years of the greatest advancements in petroleum industry equipment and services will be dramatically presented — and concentrated for quick review.

147 EXPLORATION Exhibits

. . . SEE advancements in electronic devices, geophysical equipment, and entirely new, ultra-sensitive instruments for the detection of oil and gas — as modern as Radar!



363 DRILLING Exhibits

. . . SEE new drilling machinery and techniques unveiled at IPE . . . Investigate their greater economy and efficiency . . . You will even hear about new "atomic" drilling!

310 REFINING Exhibits

. . . SEE the new amazing processes and equipment developed through research and engineering during the past five years in refinery laboratories . . in natural gasoline and petro-chemicals. Everything imaginable is obtained from a drop of crude oil!

390 PRODUCTION Exhibits

. . . SEE new developments for increasing production, — secondary recovery — improved separation and treating—better, safer storage, servicing, workover.

363 PIPELINE Exhibits

. . . SEE the thrilling saga of the pipeliners — the truly heroic achievements with plastic pipe, new coatings and other new diversified products and services by manufacturers and allied industries in transporting petroleum.

SCIENTIFIC Exhibits

. . . SEE the phenomenal accomplishments of applied science in all phases of the petroleum industry — to be dramatically presented both in the Exposition's HALL OF SCIENCE and in the many company exhibits.

Plan Now to Attend
THE WORLD'S FAIR OF THE PETROLEUM INDUSTRY

ADEQUATE HOUSING ASSURED ALL IPE VISITORS

To supplement first class hotel rooms, the IPE Housing Bureau has secured and checked for quality over 1500 homes, many near the exposition grounds. These rent for $5 to $12 per day per person, and many companies are arranging accommodations for their men in these homes, where there are facilities for entertaining as well as sleeping quarters. Write now for reservations: IPE Housing Bureau, 616 South Boston, Tulsa, Oklahoma.

An unbeatable team for temperature measurement

DYNALOG RECORDERS and DYNATHERM BULBS

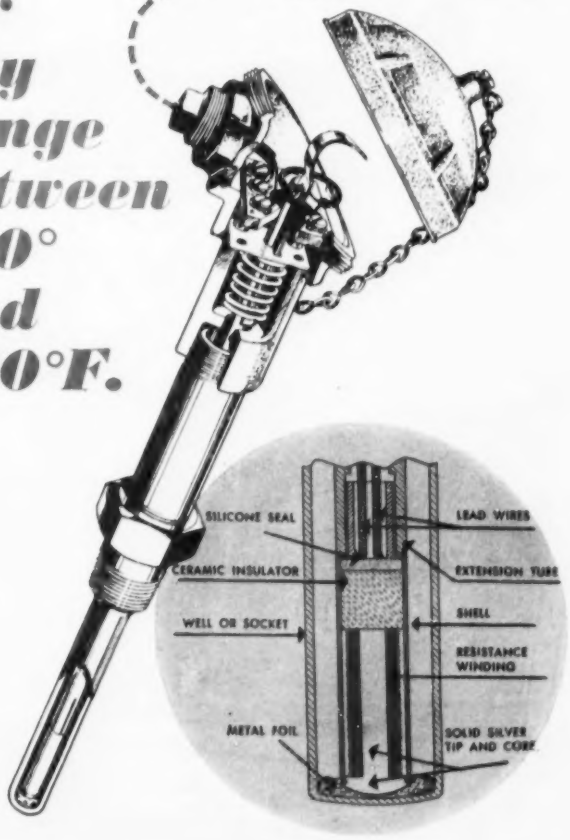
You can't beat this Foxboro Dynalog-Dynatherm combination for insuring better temperature measurement on any job between −100° and +600°F. It gives you every advantage of speed, accuracy, long leads, simple installation, economy, and freedom from maintenance. This is why:

The Dynalog Electronic Recorder has an exclusive variable-capacitor measuring system which eliminates slidewires, gears, cables, high speed balancing motors . . . no dead space, no batteries to standardize, no motors to service. Standard full-scale pen speed only 3 seconds. Sustained accuracy ¼ of 1% guaranteed. Available for spans as narrow as 5°F. with full-accuracy calibration.

The Dynatherm Resistance Bulb has unique features including metal-to-metal end-contact which, when installed in a well or socket, gives a speed of response unsurpassed by any other similarly protected temperature-sensitive element. Exceptionally rugged and permanent in calibration.

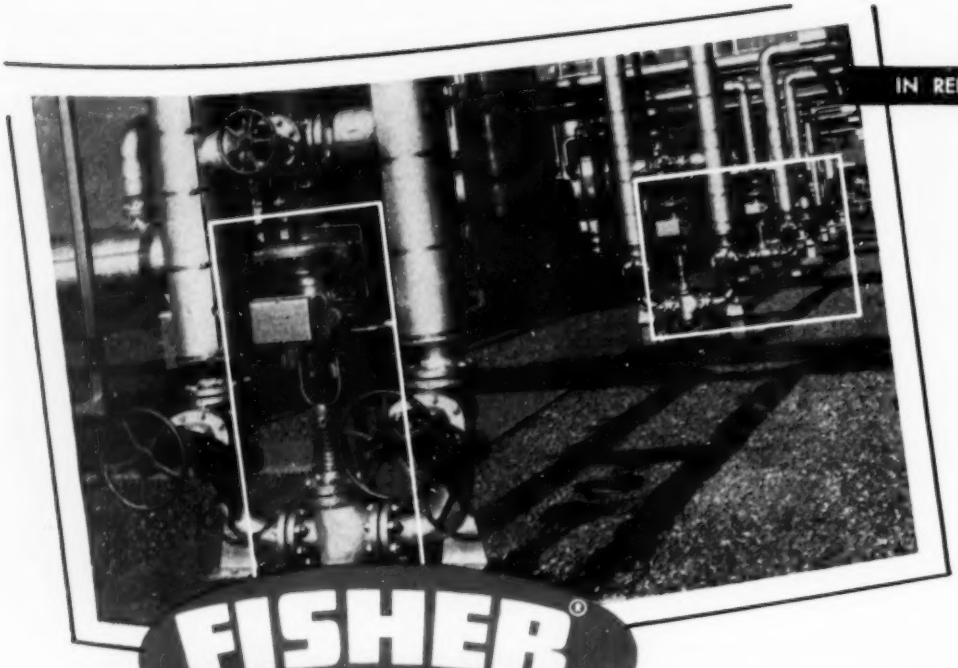
These are only a few of the important advantages of this better temperature measuring system . . . available also for control of temperatures, or with Multi-Record Dynalog Recorder for up-to-6 records on one chart. Write for illustrated bulletins. The Foxboro Company, 913 Neponset Ave., Foxboro, Mass., U.S.A.

for any range between −100° and +600°F.



FOXBORO REG U S PAT OFF **INSTRUMENTATION**

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND



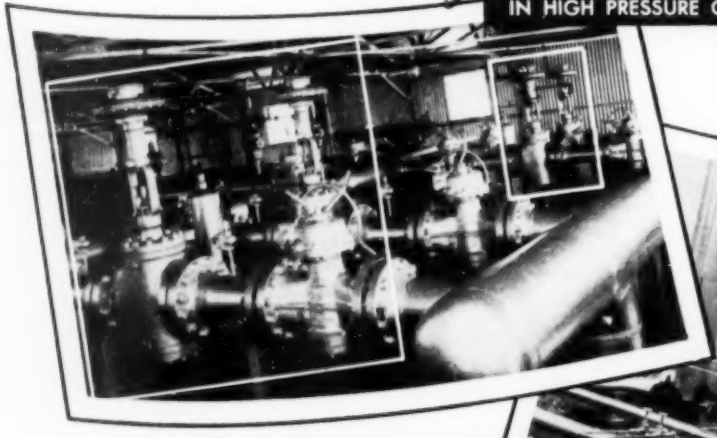
IN REFINERIES

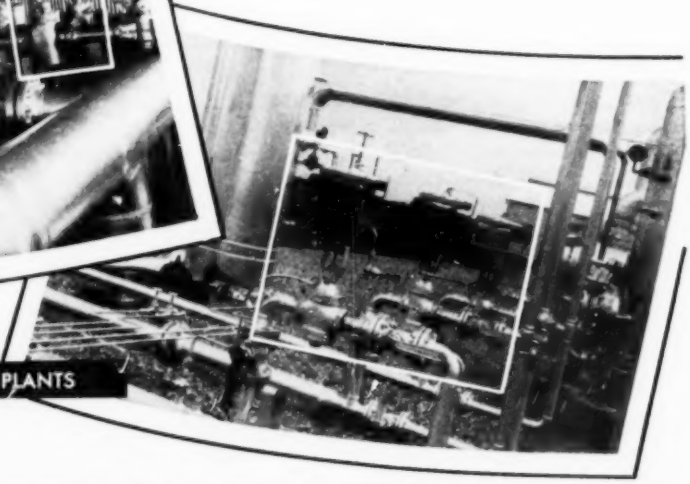
FISHER®

Pressure Regulators, Diaphragm Motor Valves, Positioners, Gas Regulators, Liquid Level Controllers, and Wizard Pressure Regulators

The Accepted Standard

IN HIGH PRESSURE GAS METERING & DISTRIBUTION STATIONS





IN NATURAL GASOLINE PLANTS

FISHER®

FISHER GOVERNOR COMPANY • MARSHALLTOWN, IOWA

WORLD LEADER IN RESEARCH FOR BETTER PRESSURE AND LIQUID LEVEL CONTROL

Hooker Chemical Guide
(ONE OF A SERIES)
USE this handy reference to save time in selecting high-quality chemicals.

HOOKER SULFUR CHLORIDES

SULFUR DICHLORIDE

Formula: SCl_2
Molecular Weight: 103.0
Appearance: Brownish red liquid with pungent odor

TYPICAL PROPERTIES

Pour Point	below —78°C
Boiling Point:	decomposes above 40°C
Cl_2 Content	66%
Sp. Gr., 15.5°/15.5°C	1.638
Flash and Fire Point	none

USES

As a chlorinating agent where use of elemental chlorine is not feasible; in chloridizing certain metallic ores; reagent in preparation of organic anhydrides, drying oils and rubber substitutes; reagent for drying coatings of ink, paint or varnish.

SULFUR MONOCHLORIDE

Formula: S_2Cl_2
Molecular Weight: 135.0
Appearance: Yellow to reddish heavy liquid with pungent odor

TYPICAL PROPERTIES

Pour Point	below —80°C
Boiling Point	138°C
Cl_2 Content	52.5%
Sp. Gr., 15.5°/15.5°C	1.6885
Flash and Fire Point	none

USES

As an intermediate and chlorinating agent in manufacture of organic chemicals, sulfur dyes, and rubber substitutes; agent for cold vulcanization of rubber products; polymerization catalyst for increasing viscosity of vegetable oils.

For more information on items listed, drop a note on your letterhead to HOOKER ELECTROCHEMICAL COMPANY, 4713 Buffalo Ave., Niagara Falls, N. Y.

HOOKER ELECTROCHEMICAL COMPANY

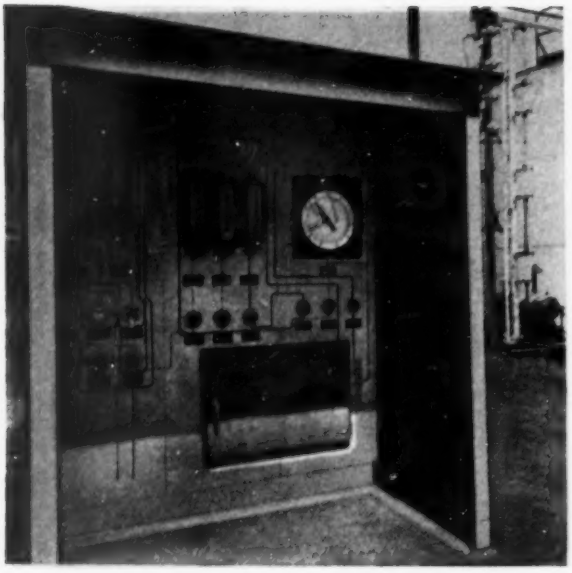
NIAGARA FALLS, N. Y. • NEW YORK, N. Y.
TACOMA, WASH. • CHICAGO, ILL. • WILMINGTON, CALIF.

From the Salt of the Earth

HOOKER® CHEMICALS

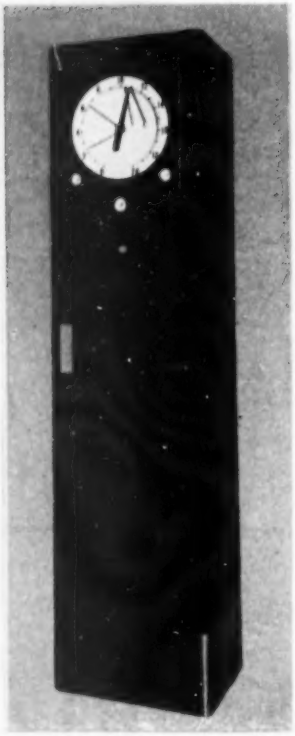
2-1527

(To obtain more data on advertised products see page 424)



infra-red analysis *tells how much of a selected component exists in gas mixtures. Here, continuous analysis recorded by an* ***ElectroniK*** *potentiometer on a refinery's graphic panel is used for actual process control.*

mass spectrometry *separates materials on the basis of their different molecular weights . . . finds what constituents are present in what quantity. Above is a "package" mass spectrometer in which an* ***ElectroniK*** *instrument records test data.*



gas analyzer, *operating on the thermal conductivity principle, combines an* ***ElectroniK*** *recorder, analysis cell and accessories in a single panel assembly.*

New concepts *utilize*

These are some of the manufacturers who use *ElectroniK* instruments in their analyzers

Products of the companies checked are illustrated on these pages

Applied Research Laboratories
√ Baird Associates
Bausch and Lomb
Beckman Instruments, Inc.
Consolidated Engineering Corporation
√ Davis Emergency Equipment Co.
√ General Electric Co.
Jarell-Ash
Mine Safety Appliances Co.
North American Philips Co., Inc.
Perkin-Elmer Corp.
√ Podbielniak, Inc.
Precision Scientific Co.
E. H. Sargent & Co.
Tracer Laboratories
Turner-Burrell Technical Supply Co.

robotized distillation apparatus *determines composition of hydrocarbon mixtures in minutes instead of hours. The temperature versus volume-distilled curve drawn by the* ***ElectroniK*** *potentiometer needs no replotting for computing analysis.*

# of process control

ElectroniK instruments

FROM the analytical laboratory comes a new concept of industrial process control, based directly on the desired chemical or physical characteristics of the product.

Continuous analyzers now make it possible to measure composition of gases and liquids accurately and automatically . . . to record this information . . . even to actuate automatic controls. Instead of temperature, pressure and flow, these new systems deal in terms of refractive index, density, ultraviolet and infrared spectra, radiation intensity and absorption.

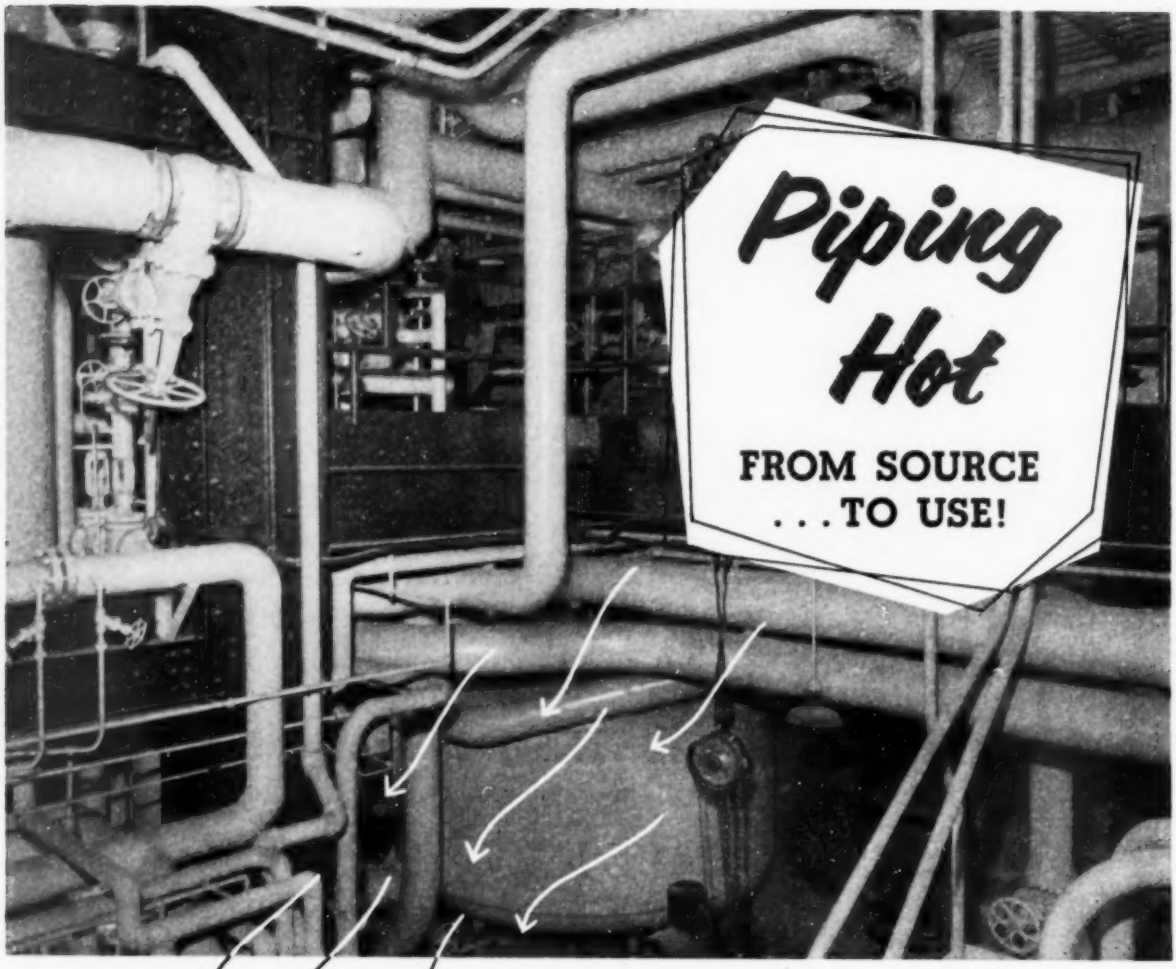
An essential component of all these systems is automatic recording. To fill this critical function, leading manufacturers of automatic analyzers choose *ElectroniK* instruments. They choose them for their exceptional accuracy, that exploits fully the inherent precision of the new measuring techniques. They choose them, too, for sensitivity that records every essential change in readily readable detail. And they prefer *ElectroniK* recorders for their simple, rugged design that guarantees dependable service under any industrial conditions.

Your local Honeywell engineering representative will be glad to discuss the role of *ElectroniK* instruments in product-analysis systems . . . or in any conventional process control. Call him today . . . he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4582 Wayne Ave., Philadelphia 44, Pa.

● **REFERENCE DATA: Write for Bulletin 15-14, "Instruments Accelerate Research."**

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls

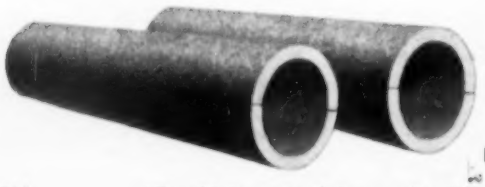


UNARCO

Unibestos®

PIPE INSULATION

for Temperatures up to 1200°F



High thermal efficiency! That's one of the features of Unibestos Pipe Insulation. It's an outstanding b.t.u. barrier.

Yes, and it's easy to fit—cuts quickly, cleanly. And Unibestos lasts and lasts because it's highly resistant to moisture, fumes, vibration, and impact.

That's why you're finding more Unibestos in more plants every day. It's made in cylinders and half-rounds in two types: No. 750 for temperatures up to 750°F.; No. 1200 for up to 1200°F. And it's also available in block-form for up to 1200°F. uses.

Phone your nearby Unarco Distributor for recommendations and prompt service on Unibestos, Amocel, and other dependable Unarco insulations. For new installations or replacements, there's nothing better.

UNION ASBESTOS & RUBBER CO.

DEPT. N-3, 332 S. MICHIGAN AVENUE • CHICAGO 4, ILL.

(To obtain more data on advertised products see page 424)

REFINERY PROCESS NEWS

PUBLISHED BY REFINERY PROCESS DIVISION, THE M. W. KELLOGG COMPANY MARCH 1953

New Sulfur Removal Process Promises Maximum Oil Yield

Because of the increasing volume of high sulfur crudes being produced, many refiners have shown considerable interest in the new desulfurization process—Autofining—which has been developed and commercially tested by the Anglo-Iranian Oil Company, Ltd.

The process has particular significance for those refiners who are running crudes from West Texas, the Middle East, West Coast and South America and who are finding it virtually impossible to meet sulfur specifications for No. 2 heating oil.

Moreover, the production of jet fuels will present many refiners with major desulfurization problems as use of this type of engine spreads. It also naturally affects all products from kerosene on down.

The Autofining process—licensed on a world-wide basis by Kellogg—has several advantages over conventional acid treating. Its most important superiority rests in the yield factor. Autofining assures yields of 98% or better on practically any virgin gas oil. This in comparison with yields which may be as low as 88 to 90% on the same stock run through acid treating equipment!

Though the initial investment is high for Autofining in comparison with acid treating, operating costs are so drastically lowered that savings in this category alone can pay out an Autofining plant in from two to three years. Beyond this are the obvious advantages of eliminating acid handling and disposal.

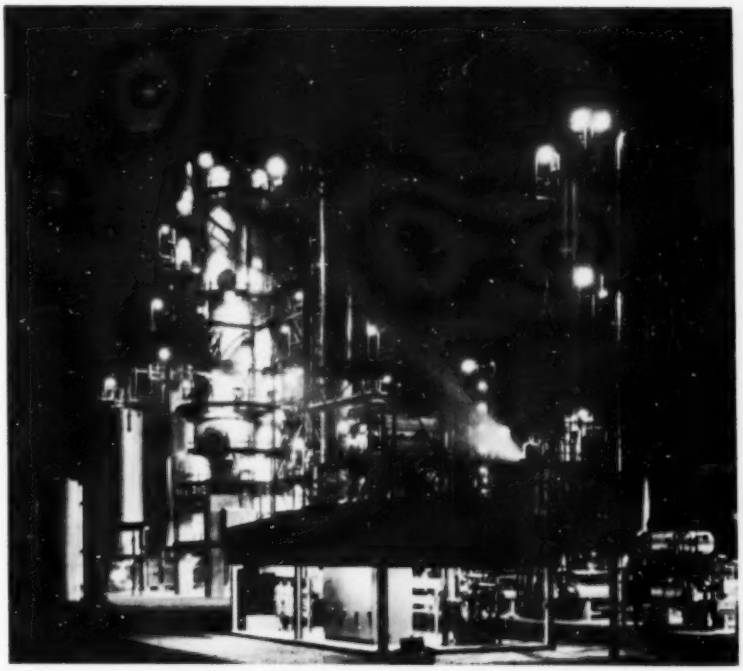
To summarize, the Autofining process offers immediate, major benefits to refiners where the need for effective desulfurization is current. And while

(Continued on following page)

Approximate Utilities for 3500 BPSD Autofining Unit

Typical Kerosene Operation

ITEM	Reaction Period	Regeneration Period	Daily Average
Period, Days	29	1	
H. P. Steam 235# G., Gen.	8000	0	7730
H. P. Steam 150# G., #/Hr., Cons.	6560	10,000	6674
Cooling Water, G. P. H.	36,000	0	34,800
B. F. W., G. P. H.	840	0	812
Fuel MM, Btu./Hr.	25	3.1	24.3
Power, KW.	20	20	20
Air SCF/Hr.		(15,000)	
Caustic—100% NaOH, #/Day	46		46
Sulfur Reduction	0.4 Wt.% to 0.1 Wt.%		



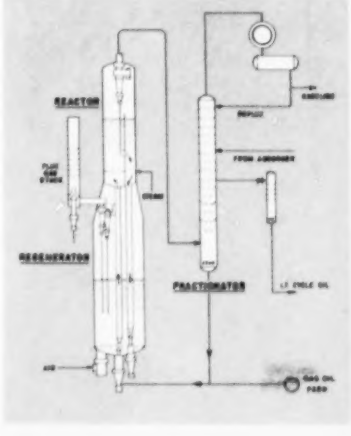
Major Refinery Modernization Program Includes the Tenth ORTHOFLOW Cracker

Part of a recent contract with a Southwestern refiner, the tenth Orthoflow Fluid catalytic cracker is now being engineered and will soon be under construction.

The first cracking unit of this exclusive Kellogg design went on stream about two years ago in Canada. Two others are now in operation in the U. S. and the Dominion. Those, either operating or planned, range in size from approximately 2,500 to 28,000 BPD fresh feed. However, with recycle, the reactor throughput of the largest is increased to 44,000 BPD.

On the whole the first three Orthoflow crackers have operated successfully, producing good yields and high quality products. As with any process unit of novel design, some operational difficulties have been experienced. These have largely centered about catalyst loss, but recently completed studies—results of which will naturally be incorporated in existing units as well as those under construction—indicate that the catalyst loss problems can be solved without appreciable effect on the recognized low investment cost of the Orthoflow.

Unchanged are the basic design advantages of the units . . . the straight-line catalyst flow . . . the highly successful plug valves which "double" as absorbers of thermal expansion . . . the upright construction with its concomitant savings in foundation and structural steel costs.



CONTINUED FROM PRECEDING PAGE

KELLOGG
FLUID CATALYTIC CRACKING
KELLOGG
FLUID HYDROFORMING
KELLOGG
LUBE PROCESSING
KELLOGG
PETRO CHEMICAL PROCESSING
KELLOGG
CAT POLY ALKYLATION
KELLOGG
DISTILLATION
KELLOGG
VACUUM DISTILLATION
KELLOGG
DECARBONIZING DESULFURIZATION

Autofining . . . cont.

virtually all demands for jet fuel can be met easily today by processors with sufficient sweet crude, either of two situations arising in the future could throw this particular demand-supply picture out of balance:

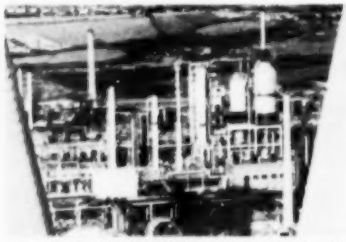
1) A war emergency requiring the majority of refiners to handle sour crudes just to meet the requirements of an "all out" Air Force, and

2) Rapid acceptance of jet propulsion by commercial airlines, coupled with continuing "cold war" demands.

AIOC has proved the process through several years of operation on 150 and 300 BPD semi-commercial units and is now operating a 3,500 BPD plant. Complete commercial processing data are available from this unit on a variety of stocks. (*Ask for a review of these data to evaluate the potential of Autofining in your processing sequence.*)

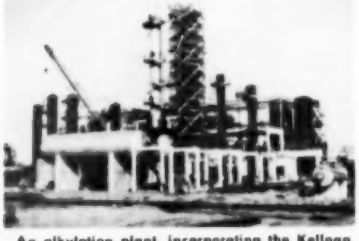
ON KELLOGG JOB SITES...

Shown below are just three of the more-than-a-score of job sites where Kellogg construction crews are erecting a variety of refinery and chemical plants in many parts of the World.

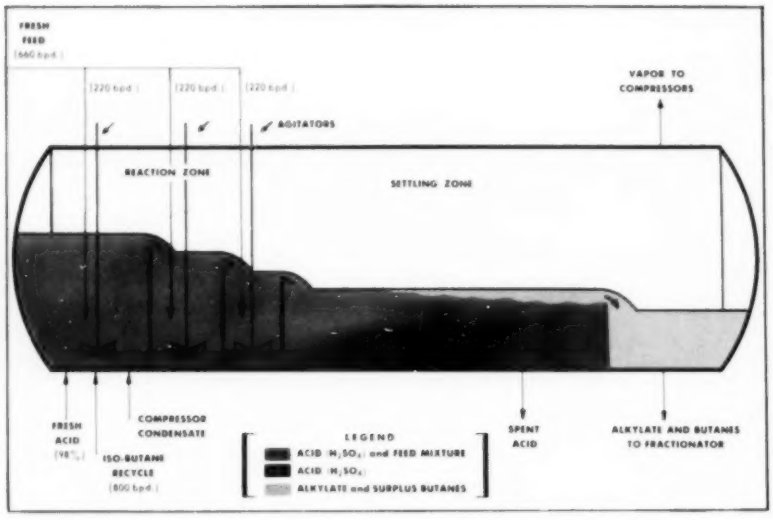


In England a Fluid catalytic cracker of the familiar side-by-side type has just been completed.

Work is progressing rapidly on a complete lubricating oil plant in the Southwest.

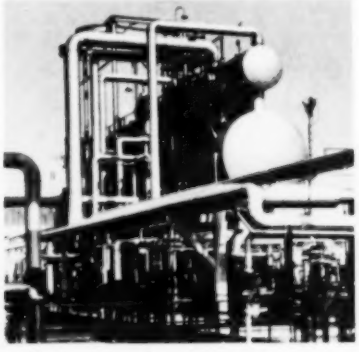


An alkylation plant, incorporating the Kellogg cascade reactor, takes shape in South America.



Cascade Reactor, Recently Introduced, Is Highly Successful in Alkylation Plants

While the intrinsic value—forgetting for the moment the expressed desire of the Government for increased avgas production—of alkylation in today's or tomorrow's refinery is a moot point with many refiners, it is a fact that, since the first units were rushed on stream during World War II, the process has undergone several major design improvements which have improved its economics.



For example, two years ago Kellogg brought out its new cascade reactor for sulfuric acid alkylation. Peculiar only to Kellogg designs, this reactor provides a most desirable high ratio of iso-butane to butylene without the additional expense of extensive iso-butane recycling equipment required in conventional plants. In addition, the overall plant design maintains acid consumption at the lowest possible level and, through the use of auto-refrigeration, keeps the initial investment at a minimum.

Three of these new reactor designs have now been put into service. A fourth will be the heart of a contract for the design and erection of a new plant in a Rocky Mountain refinery. Experience with the novel reactors, which have undergone even further refinements since the first was installed two years ago, has shown exceptionally high yields of superior alkylate with concomitant savings in utilities and other operating costs.

For further information, technical data, etc., on any refining process, write

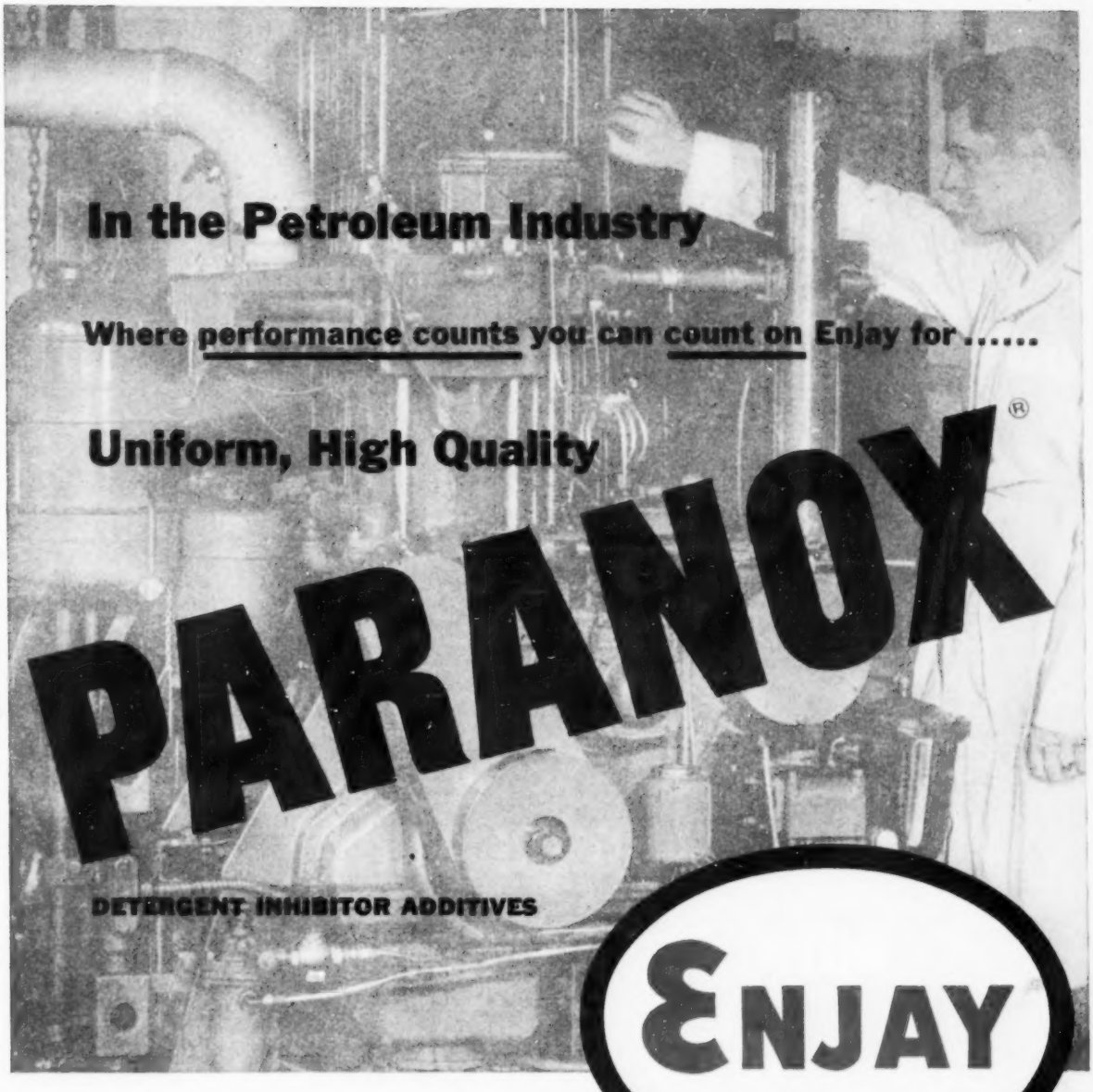
REFINERY PROCESS DIVISION

THE M. W. KELLOGG COMPANY

225 Broadway, New York 7, N. Y.

or offices in Jersey City, Los Angeles, Tulsa, Houston, Toronto, London & Paris

KELLOGG — A DIVISION OF PULLMAN



A pioneer and leading marketer of detergent inhibitor additives, the Enjay Company with its affiliates has constantly expanded its PARANOX production facilities to keep pace with the greatly increased demands of the petroleum industry. More and more refineries and marketers of leading motor oils are using Enjay PARANOX additives to improve the quality of their products.

A complete line of dependable products for industry

PETROLEUM	SURFACE COATING	CHEMICAL
PARANOX	PETROHOL 91	PETROHOL 91
PARATONE	PETROHOL 95	PETROHOL 95
PARAFLOW	PETROHOL 99	PETROHOL 99
PARAPOID	Secondary Butyl Alcohol	Iso-Octyl Alcohol
PARADYNE	Secondary Butyl Acetate	Decyl Alcohol
PARATAC	Isopropyl Acetate	Tridecyl Alcohol
ENJAY Anti-Freeze	Acetone	Dicyclopentadiene
PETROHOL	Methyl Ethyl Ketone	Isoprene
Methyl Ethyl Ketone	Ethyl Ether	Butadiene
Dewaxing Aid	Isopropyl Ether	Ethyl Ether
Ethyl Ether	Dicyclopentadiene	Isopropyl Ether
Isopropyl Ether	Naphthenic Acids	Tripropylene
Reference Fuels	Iso-Octyl Alcohol	Tetrapropylene
	Decyl Alcohol	Aromatic Tars
		Acetone
		Methyl Ethyl Ketone

The Enjay Company has long been recognized as a leader in the development and marketing of high-quality products for the oil, surface coating and chemical industries. Backed by greatly expanded plant and distribution facilities, the Enjay Company is supplying a constantly growing list of chemical products to many different industries.

BE SURE TO CALL ON ENJAY FOR YOUR CHEMICAL NEEDS

ENJAY COMPANY, INC.

15 West 51st Street, New York 19, N. Y.

(To obtain more data on advertised products see page 424)

DID YOU KNOW THAT
UNIVERSAL SERVICE PROTECTS
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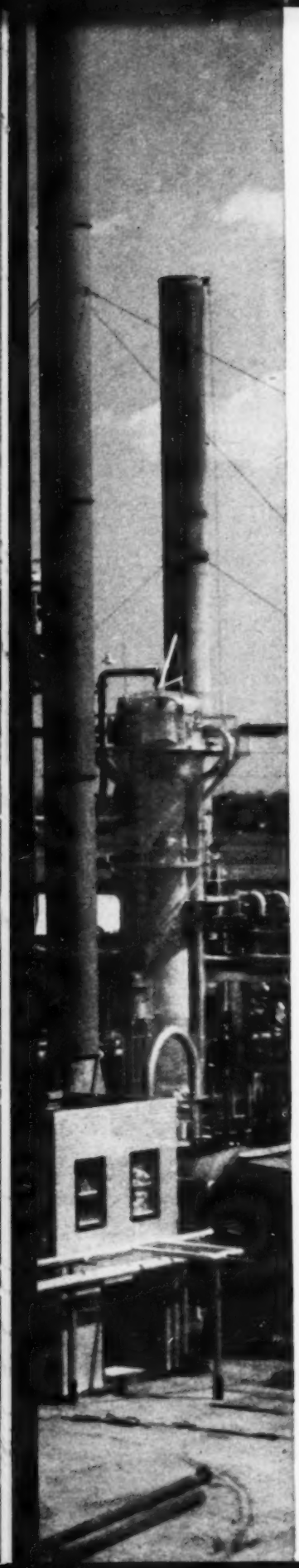

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When Butane says "HANDLE WITH CARE"

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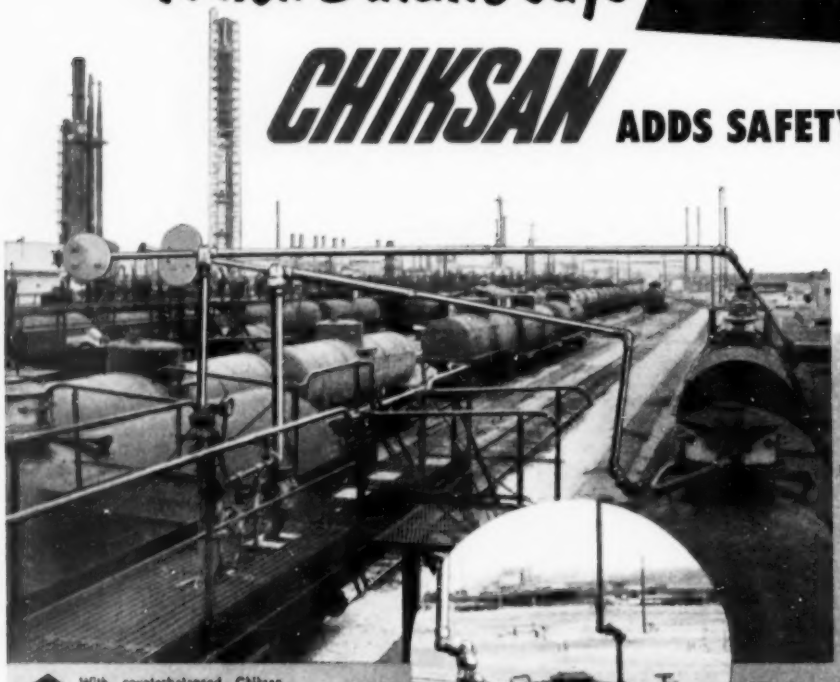


With counterbalanced Chiksan loading racks, one man can quickly and easily make connections to tank cars.

CHIKSAN low pressure swivel joints employed here on both supply and return lines insure safety, speed and economy in loading tank cars.

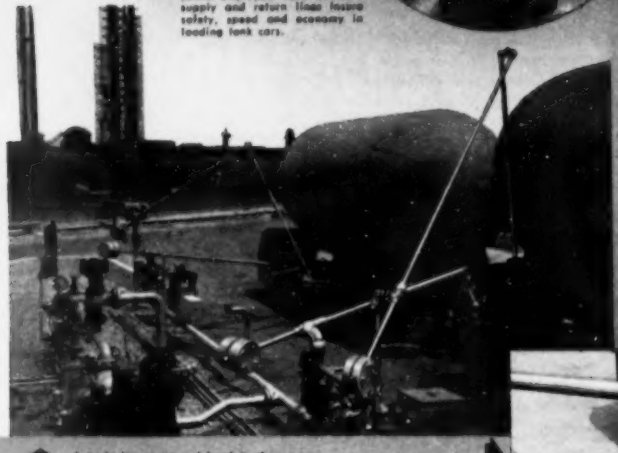
It takes speed, safety and kid-glove handling to keep up the massive flow of liquefied petroleum gas at Standard Oil Company of California's El Segundo plant.

Chiksan provides the necessary liquid-tight, gas-tight unions, the characteristic flexibility of motion to keep the touchy Butane flowing at a swift, even pace with safety to workers, plant and community — with profit to the company.

No less than eight Chiksan Ball-Bearing Swivel Joints are needed for each loading installation to keep the gas moving into tank and truck—to provide the essential carry-off of the highly explosive vapors. And with Chiksan on the job, metal of relative low porosity takes the place of more porous and less safe rubber.

Standard Oil Company of California's El Segundo installations are typical of industry's reliance on Chiksan Ball-Bearing Swivel Joints around the world to speed the flow of enterprise — to promote production and defense—to increase safety—to protect profits.

Wherever liquid or gas must flow in industry — wherever hydraulic systems can add efficiency and economy—Chiksan Ball-Bearing Swivel Joints are on the job. If more flexibility—greater stamina—longer life and added economy are of interest to you, Chiksan's Research and Development Division can help you find a better, swifter way.



A typical near ground level truck loading rack using CHIKSAN joints on supply and return lines.

Close up of CHIKSAN low pressure joints on supply and return lines in truck loading of Butane.

The Flow of Enterprise Relies on **CHIKSAN** *Ball-Bearing Swivel Joints*

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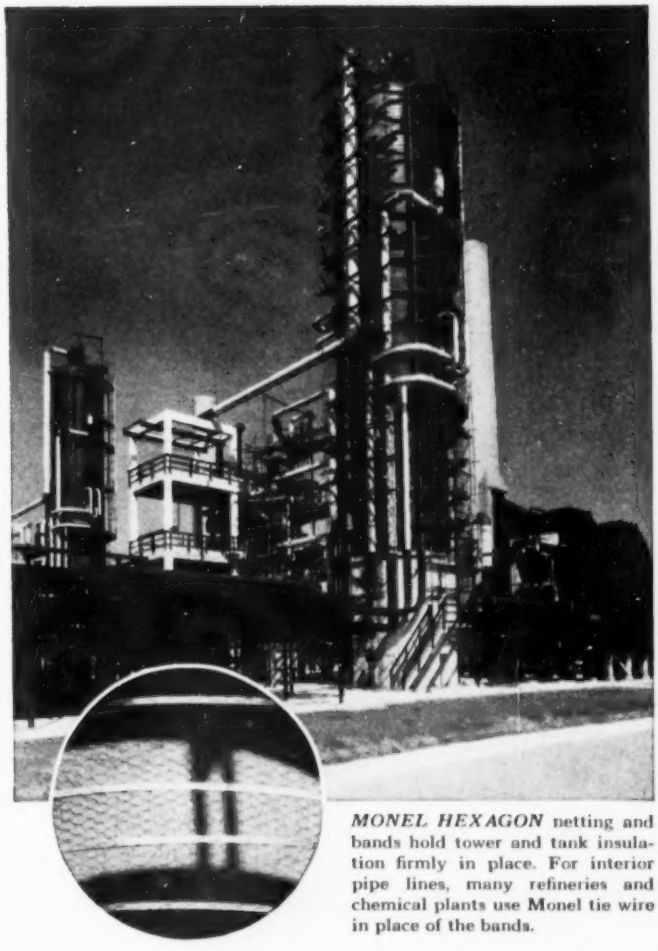
(To obtain more data on advertised products see page 424)

How to Insulate Your Towers against rising maintenance costs



MONEL HEXAGON netting and bands hold tower and tank insulation firmly in place. For interior pipe lines, many refineries and chemical plants use Monel tie wire in place of the bands.

One simple step can help you hold tower insulation replacement costs within bounds.

Use Monel® hexagon netting . . . Monel bands . . . Monel tie wire.

Monel successfully resists corrosive attack by moisture and acid or alkaline fumes... It prolongs the life of insulation in damp and humid areas, coastal locations, and the corrosive atmospheres of industrial locations.

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You can see, then, how Monel is almost certain to bring you important economies over the years. Monel-secured tower insulation goes on easily... stays tight... lasts long... saves frequent erection of expensive scaffolding.

For your next tower – or tower repair job – insure permanence and future savings by using Monel hexagon netting, and Monel bands and tie wire. Consult your Distributor of Inco Nickel Alloys for the latest information on their availability. Remember, too – it always helps to anticipate your requirements well in advance. The International Nickel Company, Inc., 67 Wall Street, New York 5, N. Y.

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A wide variety of types of metals are available for highly corrosive applications. Coils can be supplied in combinations of cupro nickel, admiralty, red brass, copper, aluminum, monel, steel, stainless steel and many other special metals. TRANE engineered products have solved corrosion problems of all types, yet obtained maximum heat transfer and maximum life from the fluid circuit.

2 Permanently bonded fins

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3 Extra-rugged construction

Framework of the TRANE Fluid Cooler is so strong it can be used for stationary or portable installation *without additional bracing*. Its simple structural design permits fastest possible erection. Yet it is more than strong enough to support core and accessories and withstand wind and shock load. Finish on the TRANE Fluid Cooler is a rubber-base paint that's completely weatherproof.

4 Freedom from vibration

TRANE Fluid Coolers run smoothly . . . quietly. They stay sound and tight longer because TRANE engineers have virtually eliminated the causes of vibration. Here's how: The variable-pitch fans are dynamically balanced. Solid, oversized fan shaft is firmly mounted in giant thrust bearings. Drive components are aligned at the factory and shipped assembled. Orifice ring is designed to *match* the fan.

Trane Dry-Type Fluid Coolers can be used profitably in hundreds of ways. Series GC for vertical discharge (shown above) is made in 6 regular sizes with fan diameters ranging from 72″ to 144″.

Jacket water cooling costs are cut to the minimum with the TRANE horizontal air stream Fluid Cooler. Series EC—available in 14 sizes with fan diameters from 18″ to 120″.

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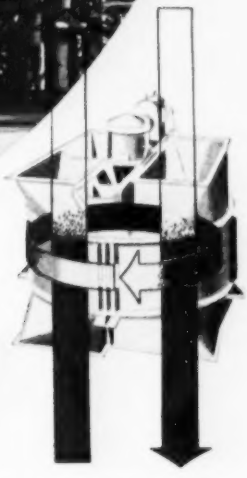

The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming cold air.

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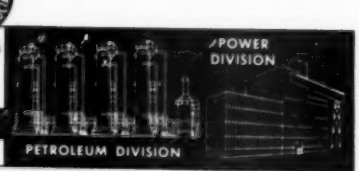

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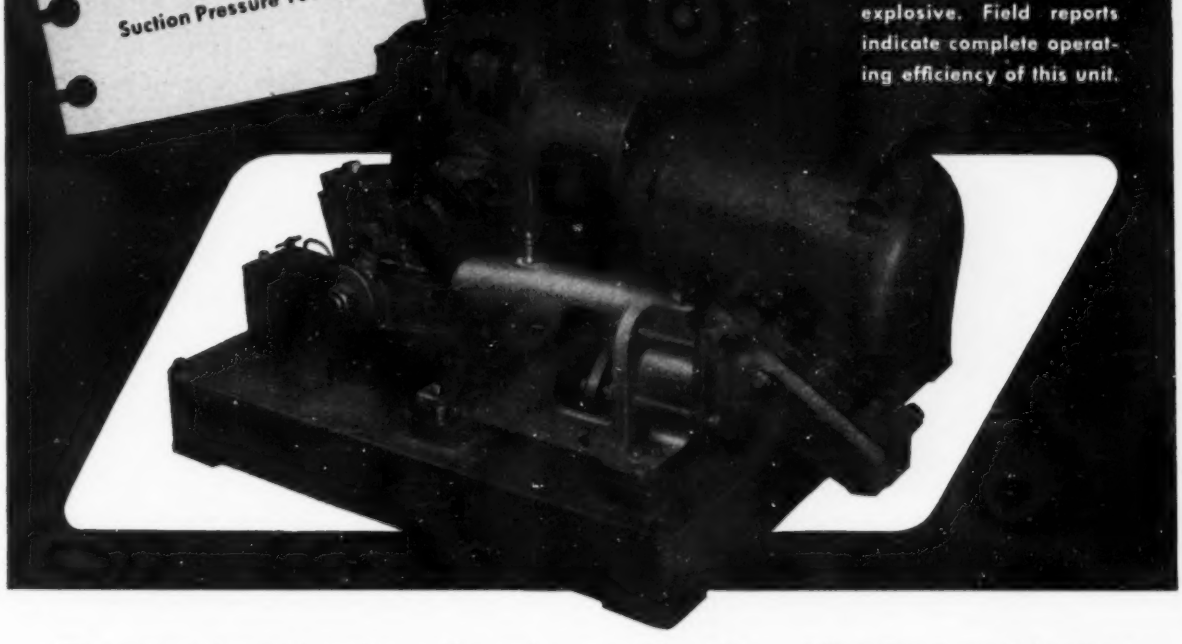

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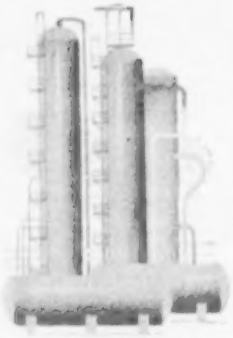

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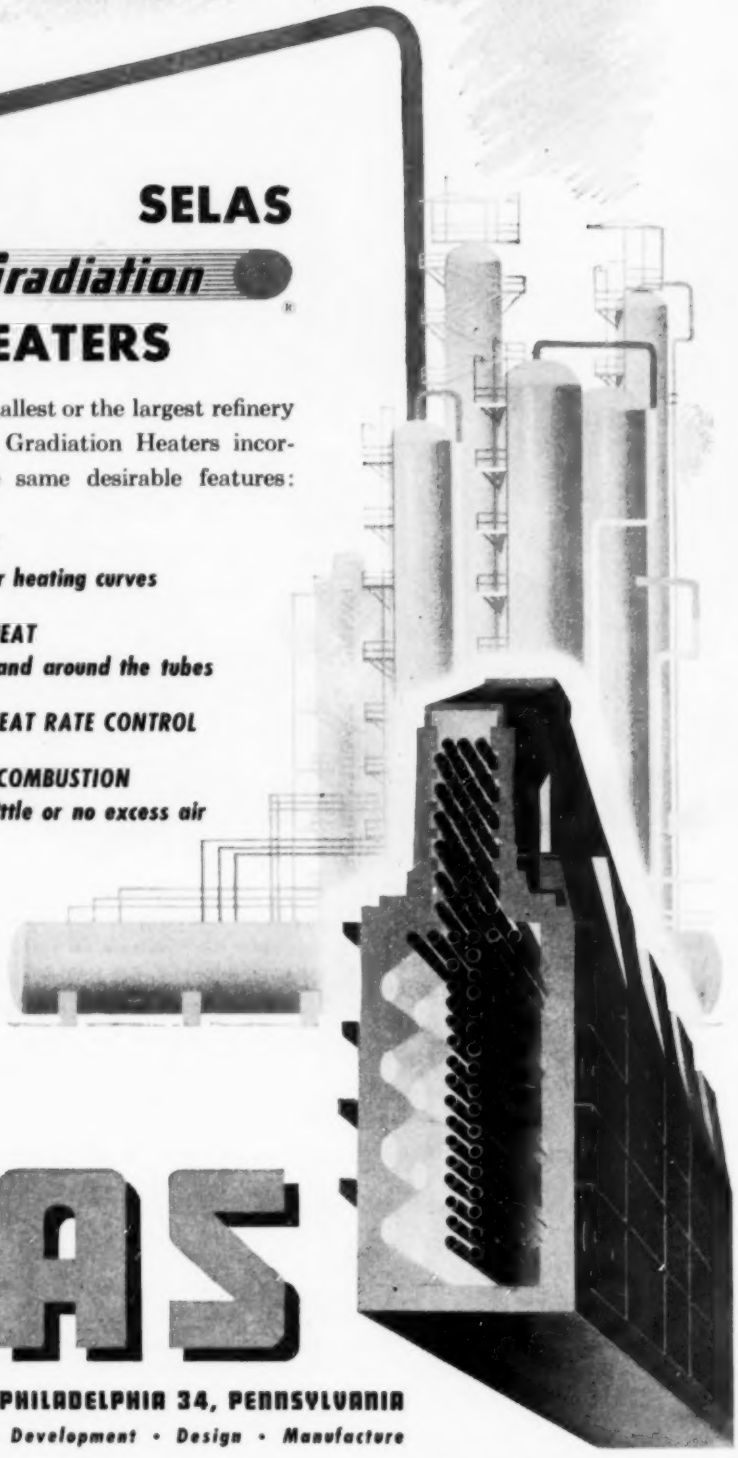

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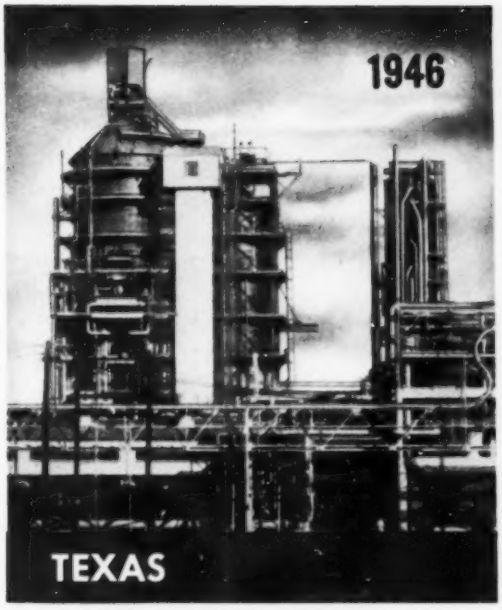

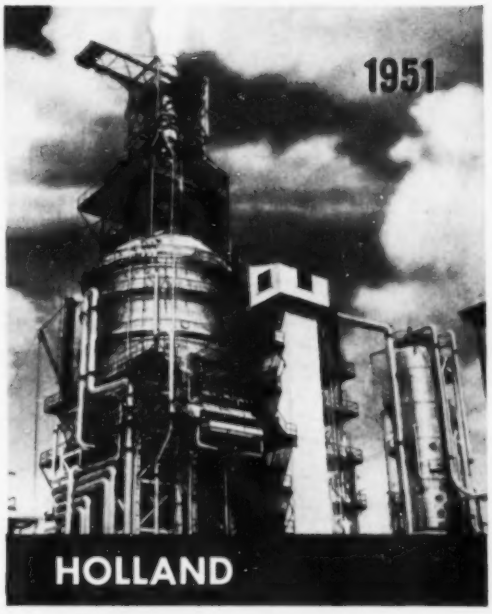

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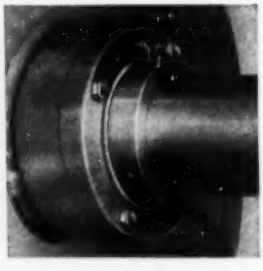
LIGHTNIN SERIES SE (gear drive). Sizes 1 to 25 HP. Also available in V-belt drive.

No wrenches needed to shut off stuffing box from tank contents

TO SHUT OFF WITH TANK FULL, operator loosens a set screw and turns handles on bronze housing. It's as easy as closing a valve.



INSIDE THE TANK, a Teflon gasket is compressed between the seal collar and end cap. This positively seals off tank contents.

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These two new LIGHTNIN Side Entering Mixers cut maintenance time in half, they're so easy to service.

When stuffing box needs to be repacked, your maintenance man just loosens one set screw. Then he easily shuts off the stuffing box from tank contents, by rotating the outboard bearing holder, which has two easy-to-get-at handles.

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A New Series on Fractional Distillation

AUTHOR Robert R. White

One of the bases of petroleum refining is fractional distillation. Technological improvement in refining processes and increasing costs of construction and operation place a premium on precise design and operation of equipment. But precise design and operation requires an extensive knowledge of the application of distillation principles. This knowledge and the use of such modern calculational techniques as the digital and the analog computers must be based upon a firm understanding of the fundamental principles of distillation.

In order to partially meet this continuing need, the editors of PETROLEUM PROCESSING have arranged for a series of articles on fractional distillation. It supplements an earlier series published in this magazine several years ago.[10-18] While the previous series dealt primarily with the distillation of binary mixtures and column design, the present series will extend the information to the distillation of ternary and multi-component systems.

Author is Robert R. White, professor of chemical engineering at the University of Michigan, Ann Arbor, Mich., and much of the work he is now reporting is the result of original studies he has conducted.

Prof. White has been on the faculty at Michigan since 1942, and a full professor since 1948. He received his B. S. degree in Chemical Engineering from Cooper Union Institute of Technology in 1936, and his M. S. and Ph. D degrees from Michigan in 1938 and 1941. After obtaining his Bachelor's degree, he worked for Calco Chemical Co. as a junior chemical engineer. During post-graduate studies at Michigan he worked on special research for Dow Chemical Co. He was later employed in the Research and Development Department of Standard of California and in the Legal Department of Universal Oil Products Co.

To Help You Design Fractionators

1 in a series—Stripping and rectifying of ternary mixtures—completely distributed components

By ROBERT R. WHITE
Dept. of Chemical and Metallurgical Engrg.
University of Michigan

THE series of papers published previously on the subjects of binary distillation,[10-13] bubble plate column design,[14-15] and ternary distillation[16-18] emphasized the graphical approach to distillation problems. The graphical approach is important not because of greater accuracy or ease in calculation but because it shows pictorially the factors which are important and their interrelationship. A clear grasp of these interrelationships gives the power to analyze accurately many of the complexities of multicomponent and azeotropic distillation and the graphs constitute "maps" which are invaluable in the effective use of mathematical relationships. The prospective extensive use of analogue and digital computers in distillation calculations especially will require a clear understanding of distillation theory.

The present series of papers presents a considerable extension of graphical techniques to multicomponent systems with primary emphasis on ternary and quaternary systems.

Stripping Columns

A study of multicomponent distillation may be initiated by inquiring into the relationship between reflux ratio, product composition and the number of equilibrium stages required in a stripping column such as is illustrated in Fig. 1. The feed stream, a liquid, is charged to the top stage, from which an overhead product vapor is withdrawn. A bottom product is withdrawn from the reboiler. The reflux ratio for a stripping column is usually called the "reboil ratio" and is the ratio of the rate at which vapor leaves the reboiler to the rate at which the bottom product is withdrawn, V_s/B.

In the interest of simplicity, this discussion considers primarily systems of constant relative volatility and constant molal overflow.

Binary Mixtures

A typical calculation for the stripping of a binary mixture determines the number of stages required to produce a bottom product containing a mole fraction x_b of the more volatile component, from a binary feed mixture containing a mole fraction x_p of the more volatile component, and having an enthalpy h_p, as a function of the reboil ratio, V_s/B, at a given pressure. This type of calculation has been described previously,[10-13] and is illustrated by the enthalpy-composition diagram in Fig. 2, where

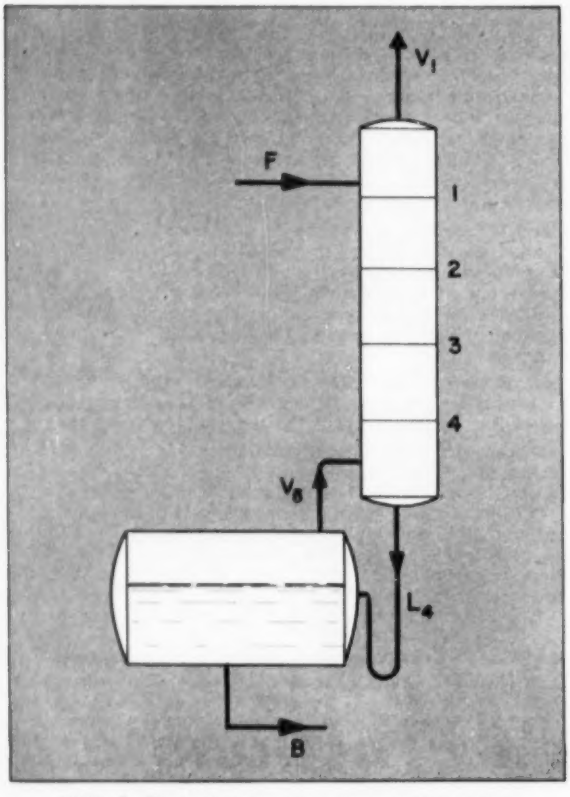

FIG. 1—Typical stripping column and reboiler

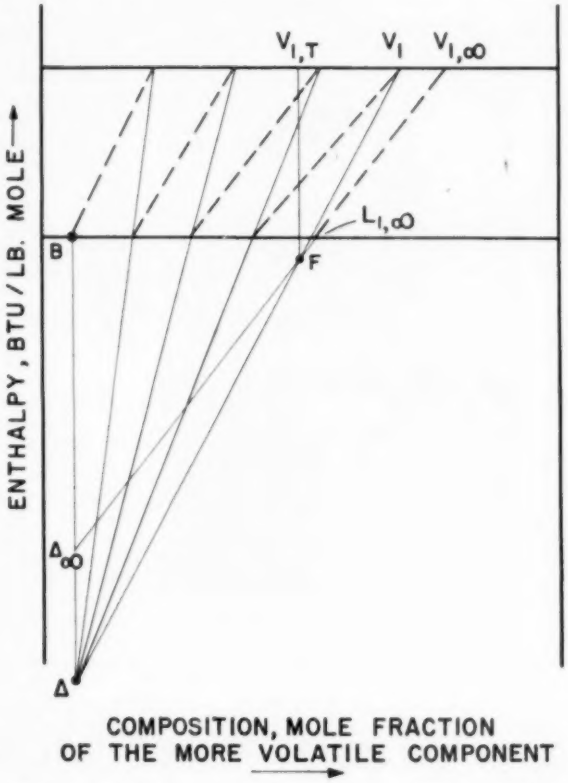

FIG. 2—Enthalpy-composition diagram, binary mixture

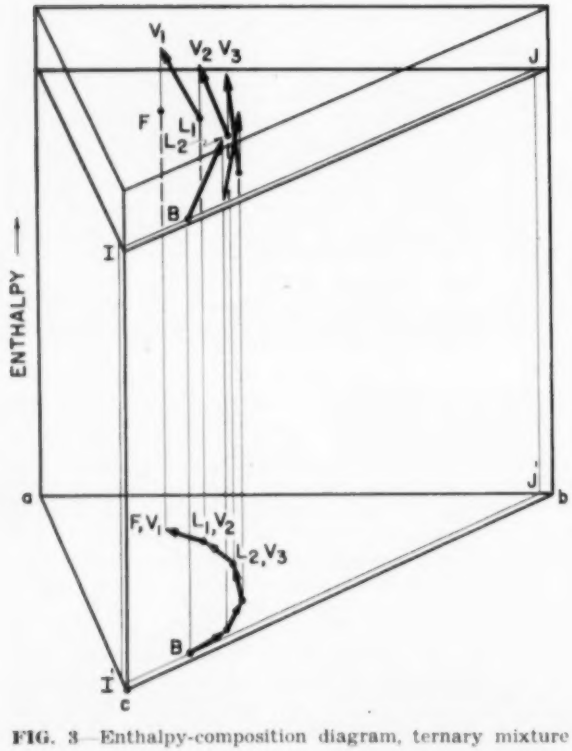

FIG. 3—Enthalpy-composition diagram, ternary mixture

point F represents the feed material and point B the bottom product.

At total reflux, ($V_s/B = \infty$) the composition of the overhead vapor product is identical to that of the feed stream so that the point $V_{1,T}$ on the saturated vapor line represents the overhead vapor, the point Δ lies at an enthalpy coordinate of ∞ and a minimum number of stages is required to produce the specified bottom product.

At a finite reboil ratio, te overhead vapor product is represented by the point V_1, the reboil ratio V_s/B being equal to the relative distance $\overline{\Delta F}/\overline{FV}_1$ and a somewhat larger number of stages being required for the separation specified.

At the minimum reboil ratio, the line $\Delta FV_{1,\infty}$ coincides with the equilibrium tie line which extrapolates through the point F, an infinite number of stages being required to fractionate from the point $V_{1,\infty}$. The minimum reboil ratio is equal to the relative distance $\overline{\Delta_\infty F}/\overline{FV}_{1,\infty}$.

The important characteristics of the stripping operation are:

1—The overhead vapor composition is a function of the reboil ratio.

2—The value of the minimum reboil ratio is a function of the separation specified since if the point B were located differently, the ratio $\overline{\Delta_\infty F}/\overline{FV}_{1,\infty}$ would have a different value.

3—The composition of the liquid $L_{1,\infty}$ and $V_{1,\infty}$ in the zone of constant composition (infinite number of stages) is a function only of the feed composition and thermal condition and is independent of the sepa-

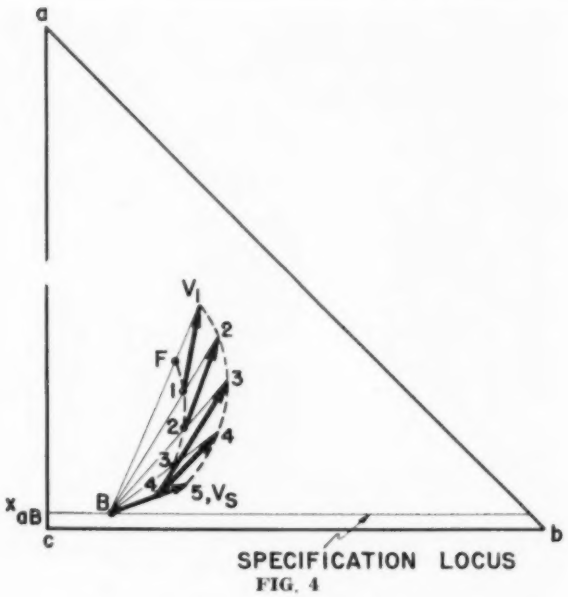

FIG. 4

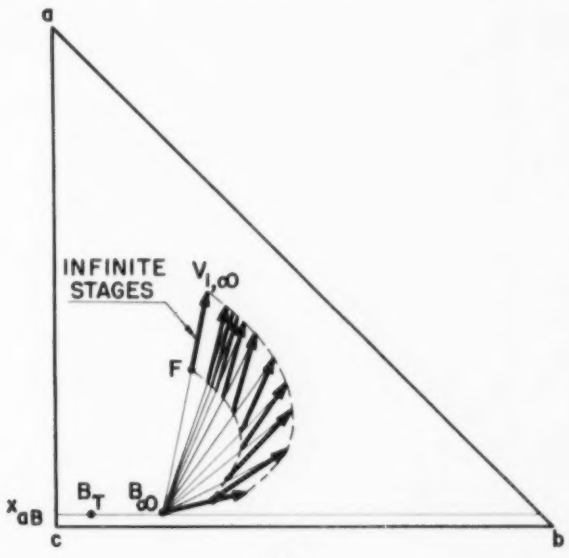

FIG. 5

ration specified, i.e. x_B, or of the value of the minimum reboil ratio.

These characteristics of a stripping operation are exhibited not only by binary systems but also, as will be shown, by multicomponent systems.

Ternary Systems

With a given feed mixture of a fixed composition and thermal condition and column pressure, it is necessary to specify only two additional variables in order to "tie up" all of the variables of a stripping operation regardless of the number of components of the mixture being fractionated.[2, 16, 17] Again, if it is desired to determine the effect of reboil ratio on the number of stages required to produce a separation, one of the variables fixed is the reboil ratio, and only one variable is available to specify the separation. Thus, in a ternary mixture containing components a, b, and c listed in the order of decreasing volatilities α_a, α_b, and α_c, respectively, one may fix only one composition variable such as x_{aB}, x_{bB}, or x_{cB}.

Consider first the case where x_{aB}, the concentration of the most volatile component in the bottom product, is specified. This method of specification ensures that all of the components shall be present in the bottom product. The enthalpy-composition diagram for the system, while of little use in quantitative calculations, is helpful in understanding the principles involved and is shown in Fig. 3, where the point F represents the composition and enthalpy of the feed, in this case a saturated liquid, and the line IJ represents all of the saturated liquids containing the specified concentration of component a.

At total reflux, the overhead vapor represented by the point V_1 has the same composition as the feed stream and stage-to-stage calculations may be initiated with this vapor. Equilibrium relations give the composition of the liquid leaving stage 1, L_1. At total reflux, the compositions of the liquid and vapor passing one another between stages are equal so that the point representing the vapor leaving stage 2, V_2, lies in the saturated vapor surface vertically above the point representing the liquid leaving stage 1, L_1. The stage-to-stage calculations are continued until a liquid product is obtained which satisfies the specifications, locating the point B representing the bottom product. Where the saturated liquid and vapor surfaces of the enthalpy-composition diagram are parallel planes, i.e., where constant molal over-flow conditions apply, it is convenient to deal with the projection of the solid diagram on the ternary composition base as shown in Fig. 3, and in the subsequent discussion only the projected diagrams will be used.

At a finite reboil ratio, it is necessary to assume a bottom product, B; to calculate the overhead vapor corresponding to the assumed bottom product by a material balance; and to check the assumed bottom product through a stage-to-stage calculation. Under conditions of constant molal overflow the ratio L/V is a constant so that the distance ratios in Fig. 4 satisfy the relation,

$$\frac{BV_4}{BL_4} = \frac{BV_3}{BL_2} = \frac{BV_2}{BL_1} = \frac{BV_1}{BF} = \frac{L}{V}$$

Thus, in effect, the material balance by which, for example, the vapor leaving stage 2, V_2, is calculated from the liquid leaving stage 1, L_1, amounts to locating the point V_2 on the line BL_1 so that $L/V = BV_2/BL_1$ or where $V_s/B = BL_1/L_1V_2$.

As the reboil ratio is decreased, the concentration of the intermediate component in the bottom product increases until, at the minimum value of the reboil ratio, the overhead vapor, V_1, is in equilibrium with the feed and the point B_x lies at the intersection of the tie line FV_1 with the specification line x_{aB} as illustrated by Fig. 5. At the minimum reboil ratio a zone of infinite stages and constant composition develops at the feed plate and the value of $(V_s/B)_{min}$ is the relative distance FB/FV_1.

Thus, in stripping a ternary system, the composition of the bottom product varies with reboil ratio as well as the composition of the distillate product. This is shown in Fig. 6, where B_T and B_x represent the bottom products at total and minimum reboil ratio, respectively, and the curved line $FV_{1,\infty}$ represents the locus of the corresponding distillate products, each pair of distillate and bottom products being connected by a straight line through F such as V_1 and B. As the reboil

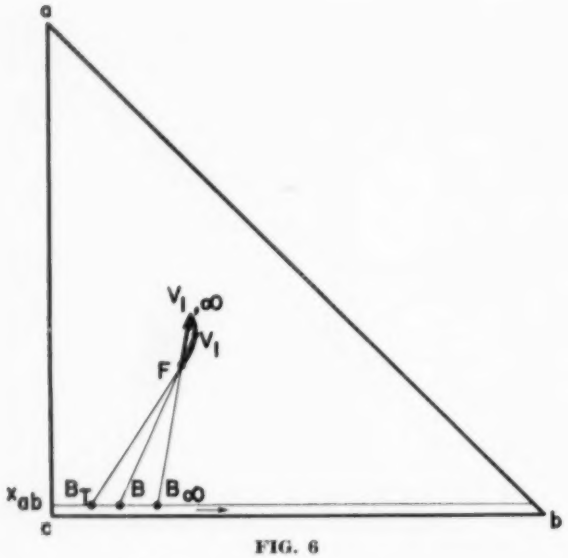

FIG. 6

ratio decreases, the bottom product composition shifts toward alignment with the equilibrium tie line originating at point *F*. This is a general characteristic of all systems in either stripping, rectifying or complete columns and regardless of the manner of specifying the separation.

Where the separation is specified so as to insure that all of the components appear in the bottom product, the zone of infinite stages at minimum reboil ratio always appears at the feed stage and the liquid in the zone has the composition of the feed stream provided it is a saturated liquid.

Rectifying Columns

A rectifying column is one which receives a feed stream in the vapor phase under the bottom stage, produces a liquid bottom product from the bottom stage and a distillate product from a reflux accumulator, as illustrated diagrammatically in Fig. 7. The general relationships established in the previous sections for stripping columns apply in all respects to rectifying columns.

For example, Fig. 8 illustrates the specification of the concentration of the least volatile component in the distillate and is analogous to the specification of the stripping column as illustrated by Fig. 5. The point most volatile component in the bottom product of a D_T represents the distillate product at total reflux ratio. As the reflux ratio is decreased the composition of the distillate product shifts until, at minimum reflux ratio, it has reached D_∞ on the extrapolation of the equilibrium tie line through the feed point, the zone of infinite stages and constant composition developing at the feed stage and the bottom product being in equilibrium with the feed.

Again, if the specification insures the appearance of all components in the distillate product at minimum reflux ratio, the zone of infinite stages appears at the feed stage and the vapor in the zone has the composition of the feed stream, provided the feed is a saturated vapor.

Example Problems—Calculation of Stages

In order to clarify the preceding discussion, the following example problem will be solved.

It is desired to strip a saturated liquid feed containing 35 mole % of component *a*, 35 mole% of *b* and 30 mole % of *c* to produce a bottom product containing not more than 1.0 mole % of component *a*. The relative volatilities of components *a*, *b* and *c* are 2.0, 1.5 and 1.0, respectively. The column to be used is shown in Fig. 1. Compute the relation between reboil rates, product composition and the number of stages required assuming constant molal overflow.

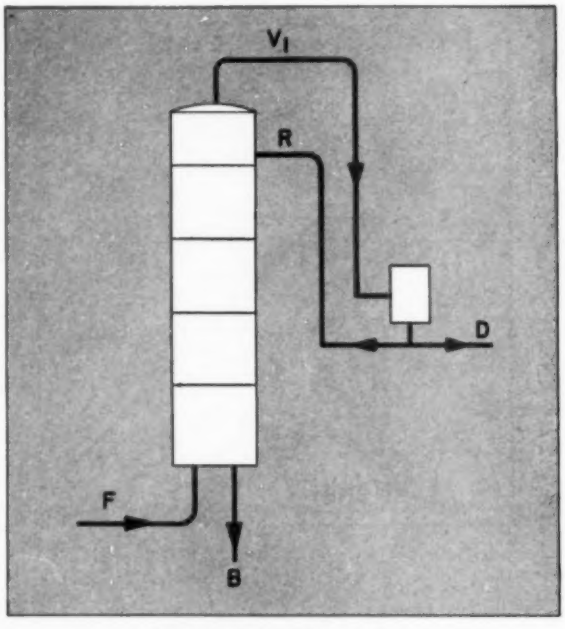

FIG. 7—Rectifying column

Minimum Reboil Ratio

Referring to Fig. 5, at the minimum reboil ratio, the following proportionality must apply[16, 17] for any component.

$$\left(\frac{V_s}{B}\right)_{\min} = \left(\frac{V_m}{B}\right)_{\min} = \frac{\overline{FB}}{\overline{FV_1}} = \frac{x_{iF} - x_{iB_\infty}}{y_{i1_\infty} - x_{iF}} \qquad (1)$$

At the minimum reboil ratio, the overhead vapor, $V_{1\infty}$, is in equilibrium with the feed, *F*, when it is a saturated liquid

$$y_i = K_i x_i \qquad (2)$$

where K_i = equilibrium volatility constant for component *i*.

$$y_i = K_r \left(\frac{K_i}{K_r}\right) x_i = K_r \alpha_i x_i \qquad (3)$$

where K_r = reference equilibrium volatility constant,
$\alpha_i = K_i/K_r$ = relative volatility.

Adding Equation 3 for all the components:

$$y_a + y_b + y_c = \Sigma y_j = 1.0 = K_r \Sigma \alpha_j x_j \qquad (4)$$

so that

$$K_r = \frac{1}{\Sigma \alpha_j x_j} \qquad (5)$$

and

$$y_i = \frac{\alpha_i x_i}{\Sigma \alpha_j x_j} \qquad (6)$$

Therefore, in Equation 1,

$$y_{i1\infty} = \frac{\alpha_i x_{iF}}{\Sigma \alpha_j x_{jF}} \qquad (6a)$$

and

$$\text{Min. Reboil Ratio} = \frac{\Sigma\,(\alpha_j x_{jF})\,(x_{iF} - x_{iB})}{x_{iF}[\alpha_i - \Sigma \alpha_j x_{jF}]} \qquad (7)$$

Letting i = component a

$$\text{Min. Reboil Ratio} = \frac{(2.0\times0.35+1.5\times0.35+1.0\times0.30)\,(0.35-0.01)}{0.35\,(2.0-2.0\times0.35+1.5\times0.35+1.0\times0.30)}$$

$$= \frac{(1.525)\,(0.34)}{(0.35)\,(0.475)} = 3.12$$

The composition of the bottom product at the minimum reboil ratio may be determined by writing Equation 7 for component a and one of the other components such as b so that

$$\left(\frac{V_s}{B}\right)_{\text{min.}} = \frac{(\Sigma \alpha_j x_{jF})\,(x_{aF} - x_{aB})}{x_{aF}[\alpha_a - \Sigma \alpha_j x_{jF}]} = \frac{(\Sigma \alpha_j x_{jF})\,(x_{bF} - x_{bB})}{x_{bF}[\alpha_b - \Sigma \alpha_j x_{jF}]}$$

From which

$$x_{bB\infty} = x_{bF}\left\{\left[\frac{\alpha_a - \alpha_b}{\alpha_a - \Sigma \alpha_j x_{jF}}\right] + \left[\frac{x_{aB}}{x_{aF}}\right]\left[\frac{\alpha_b - \Sigma \alpha_j x_{jF}}{\alpha_a - \Sigma \alpha_j x_{jF}}\right]\right\} \qquad (8)$$

Substituting the values, since the above calculation showed that $\Sigma \alpha_j x_{jF} = 1.525$

$$x_{bB\infty} = 0.35\left\{\left[\frac{2.0 - 15}{2.0 - 1.525}\right] + \left[\frac{0.01}{0.35}\right]\left[\frac{1.5 - 1.525}{2.0 - 1.525}\right]\right\} = 0.368$$

and the bottom product composition with infinite stages and the minimum reboil ratio is

Component	Mole Fraction
a	0.01
b	0.368
c	0.622
	1.000

Total Reflux—Minimum Stages

The Fenski-Underwood equation[1, 5] is used to compute the operation at total reflux

$$n = \frac{\log\left(\frac{x_{i,n}}{x_{j,n}}\right)\left(\frac{x_{j,o}}{x_{i,o}}\right)}{\log\left(\frac{\alpha_i}{\alpha_j}\right)} \qquad (9)$$

where the subscript n refers to liquids leaving stage n and the subscript o refers to liquids entering stage 1, or in another form

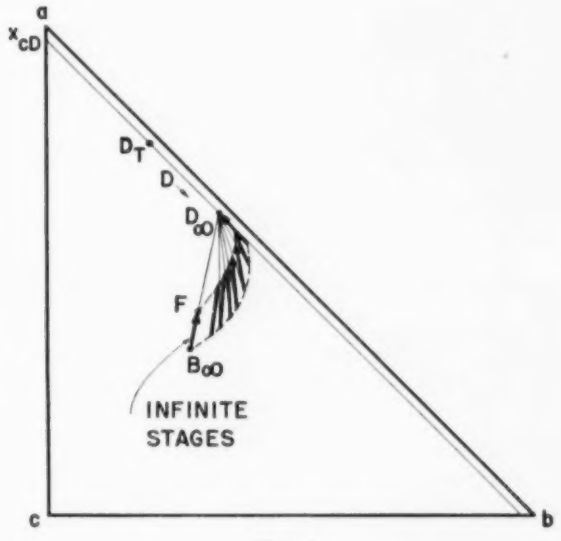

FIG. 8

$$\left(\frac{x_{i,n}}{x_{j,n}}\right)\left(\frac{x_{j,o}}{x_{i,o}}\right) = \left(\frac{\alpha_j}{\alpha_i}\right)^n \qquad (9a)$$

Letting $i = a$, and $j = b$ in Equation 9a and solving for x_{bB}, since $x_n = x_B$ and $x_o = x_F$

$$x_{bB} = x_{aB}\left(\frac{x_{BF}}{x_{aF}}\right)\left(\frac{\alpha_a}{\alpha_b}\right)^n \qquad (10)$$

$$x_{cB} = x_{aB}\left(\frac{x_{cF}}{x_{aF}}\right)\left(\frac{\alpha_a}{\alpha_c}\right)^n \qquad (11)$$

Then

$$x_{aB} + x_{bB} + x_{cB} = 1.0 = \frac{x_{aB}}{x_{aF}}\left[x_{aF} + x_{bF}\left(\frac{\alpha_a}{\alpha_b}\right)^n + x_{cF}\left(\frac{\alpha_a}{\alpha_b}\right)^n\right] \qquad (12)$$

Substituting the values in Equation 12

$$1.0 = \frac{0.01}{0.35}\left[0.35 + (0.35)\,\frac{2.0^n}{1.5} + (0.30)\,\frac{2.0^n}{1.0}\right]$$

From which $n = 6.74$

and from Equations 10 and 11

x_{aB}	0.010
x_{bB}	0.069
x_{cB}	0.921
	1.000

Stage Requirements at Intermediate Reflux

When the ratio V_s/B is some finite value such as 6.0 the quantity of the bottom product, B, is fixed since under constant molal overflow conditions the quantity of overhead product V_1 is equal to the quantity of vapor leaving the still, that is,

$$F = V_1 + B = 1.0$$
$$V_s/B = V_1/B = 6.0 \text{ or } V_1 = 6.0B$$
$$\text{and } B = F/(1.0 + 6.0) = .1428$$
$$\text{and } V = 0.8568$$

Since the proportions of F, B and V_1 are fixed by fix-

ing the value of V_s/B, the straight line BFV_1, representing the overall material balance, must pass through F, the point B must lie somewhere on the line representing 1.0 mole-% component a (specification line) and the point V_1 on a line parallel to the specification line located so that any straight line through F divides into segements such that $FV_1/FB = B/V_1$. The location of the points B and V_1 on these lines and, in other words, the determination of the composition of streams B and V_1 depends upon trial and error stage to stage calculations.

The trial and error stage to stage calculations are begun by assuming the location of the point B representing the composition of the liquid leaving the still. This assumption fixes the vapor V_1 leaving the stripping column. The calculation of compositions in the column can be started either at the top of the column or with the still.

If the calculations are started at the top of column, the liquid L_1 leaving the top stage of the stripping column is located at the end of the equilibrium line through V_1. The stream B is the difference between the liquid feed and V_1 and is also the difference between the vapor and liquid passing each other between any two stages of the column.

Thus the vapor rising from the stage below the feed can be determined by a material balance and must lie on the line BL_1 so that $BV_2/BL_1 = F/V_1$. While the point V_2 can be located graphically, it is usually necessary to calculate the composition of V_2 by a material balance since the distances dealt with on the composition diagram are small and thus the graphical method is subject to considerable error unless unusual care is taken.

The liquid leaving stage 2 can now be calculated and lies on the equilibrium tie line from V_2. Again, the bottom stream is the difference between the liquid L_2 and the vapor V_s, and thus V_3 lies on the line BI_2 so that $BV_3/BL_2 = F/V_1$ or the point V_3 is preferably located by calculating the composition of the stream V_3 by a material balance.

The stage to stage calculation is continued until point B is passed. If the correct composition of the bottom product is assumed one of the calculated liquid compositions will agree with the assumed bottom product composition resulting in a diagram similar to that of Fig. 4. Rigorously, if the agreement is not exact, a new bottom product must be assumed and the calculation repeated. However, if the agreement is fair and a smooth curve through the liquid composition extrapolates through B, a practical result may be obtained by estimating a fractional stage along the smooth curve.

Feeds Other Than Saturated Liquids or Vapors

As was discussed in the stripping of binary mixtures, Fig. 2, the composition in the zone of infinite stages at the top of a stripping column or the bottom of a rectifying column is determined by the equilibrium tie line which passes through or may be extrapolated through the feed point F. Also, it is the zone at the end of the stripping or rectifying column which connects through unique paths of fractionation to other zones of infinite stages in complex systems. Thus, for unsaturated feeds to stripping columns or for superheated feeds to rectifying columns, it is necessary to locate the equilibrium tie which extrapolates through the feed point.

For systems of constant molal overflow, it may be assumed that the enthalpy of the saturated liquids is a constant and the enthalpy of saturated vapors is a constant. Thus, applying the proportionalities used throughout the discussion for a system of n components,

$$\frac{x_{iF} - x_i}{y_i - x_i} = \frac{h_F - h}{H - h} \qquad (13)$$

from which

$$x_i = \frac{x_{iF}}{\frac{\alpha_i}{\Sigma \alpha_j x_j} + 1 - \frac{h_F - h}{H - h}} \qquad (14)$$

The composition of the liquid end of the equilibrium tie line through the feed, x_i, may be calculated from Equation 14 by assuming a value of $\Sigma \alpha_j x_j$ such that $x_i = 1.0$.

Real Systems

Many of the mixtures encountered in petroleum refining give constant molal overflow conditions in coiumns but show a variation in the relative volatilities, which while not sufficient to produce azeotropes, do not fit the assumption of constant relative volatility. With such systems, the preceding discussion of minimum reboil ratio and reflux ratio applies, provided the deviation from constant relative volatility is not sufficient to produce an infinite stage zone between the feed stage and the product end of the column, as is sometimes the case, for example, in the rectification of the famous ethanol-water system. The calculations for total reflux should be modified by using relative volatilities which are the geometric mean of the values at the ends of the column, i.e.

$$\alpha_{ave.} = (\alpha_{top} \times \alpha_{bottom})^{1/2} \qquad (15)$$

Analytic Relations for the Number of Stages

Recent publications of Underwood [6-9] and others [3, 4] have provided analytic relations between reboil ratio and the number of stages. These will be considered in later articles.

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Nomenclature

B = molal rate of flow of bottom product
F = molal rate of flow of feed
K = equilibrium volatility constant
L = molal rate of flow of liquid
V = molal rate of flow of vapor, moles per unit time
n = number of stages
x_i = mole fraction of component i in a liquid stream
y_i = mole fraction of component i in a vapor stream
α = relative volatility
$x_i = x_a + x_b + \ldots + x_i + \ldots$

Subscripts

m = refers to plate in a stripping column section
a, b, c, i, j, r = refers to components a, b, c, i, j, r
∞ = identifies a stream or composition with an infinite stage operation

Old Analyis Problem Solved. Morris Dundy, chemist at Beacon research center of The Texas Co. checks flow rate of nitrogen in a microcombustion train which he and another Texaco chemist, Erwin Stehr, designed for the direct determination of oxygen. A modification of the Schutze-Unterzaucher method, the Dundy-Stehr method overcomes a major defect inherent in the earlier technique—inaccuracy. It is further useful because of its ability to analyze minute samples—the only amounts available in many instances.

Signboards Sell Safety at a petrochemical plant (left), and in a refinery (right). Shell Chemical Co. safety inspector R. C. Mobley and safety committee chairman C. H. Hahn point to "tire" sign marking 800 safe days at Torrance, Calif., butadiene plant. At Esso Standard Oil's Bayway refinery: Joseph Bianco shows 5½-lb. stud-bolt which fell from a tower and would have cracked his skull but for the "Skullgard" that he was wearing. James Sergi exhibits cracked safety goggles that stopped a flying chunk of concrete from blinding him.

Electric Power for Refineries

—Its generation and distribution

By R. F. LAWRENCE and H. B. THACKER
Westinghouse Electric Corp.

PROBLEMS of generation and distribution of power in petroleum refineries do not differ widely from those encountered in large industrial plants.

The power source for a refinery usually consists of one or more generating plants, often supplemented by a utility tie, and the electrical loads are distributed over a relatively large area. A considerable quantity of steam is used in the refinery processes, and one of the major problems is obtaining a proper balance between the steam load and the electrical load.

The kilowatts that can be generated are frequently dictated by the steam requirements which determine steam flow in the turbines. This aspect of the problem is most important; but while being recognized, it is outside the scope of this paper. This discussion is confined to the electrical aspects of the problem of power generation; such as bussing arrangements, reliability, voltage class, ties to electric utility systems, and—in particular—circuit breaker applications. The problem of power distribution is closely integrated to the problems associated with power source and, among other factors, depends on the magnitudes, location, and type of load to be served.

A wide number of bussing arrangement can be used in an industrial generating plant. Quite a few electrical layouts within the realm of experience of the authors have been plagued with the problem of too low a generating voltage for the generating capacity involved. The result in many cases was the exceeding of available circuit breaker ratings; thereby necessitating the introduction of a higher voltage for additional capacity. These situations have resulted from expansion of the electrical system to supply the refinery facilities necessary to meet today's demand for petroleum products.

Many large, older refineries have generating capacity at 2400 volts, a justifiable voltage in view of its being the utilization voltage of large motors. Generation at this voltage permits utilizing much power without a transformation, except for the 480 volt loads. These same refineries have added generating capacity or utility ties at a higher voltage in order economically to apply necessary switchgear.

Fig. 1 shows some common generating station bus arrangements. In attempting to generalize the problem, difficulties are encountered because of the large number of variables. The following factors enter each individual problem, thus making any one case unique:

1—Number of generating plants, utility ties if used, physical location, and distance between power sources.

2—Number of generators per plant, individual generator ratings, total plant capacity, and capacity of utility ties.

3—Impedances of system elements, such as transformers, tie lines, generators, and also large synchronous and induction motors which contribute to fault currents.

4—Allowable voltage drops for normal and emergency operating conditions.

5—Total electrical load to be supplied, its location, service continuity desired, need for spare generating capacity.

Some generalizations can be made with certain assumptions. The results obtained illustrate the principles involved.

Application of Switchgear

For the bussing arrangements *A*, *B*, *C*, *D*, and *E* of Fig. 1, (these being most common) maximum short circuit capacity was calculated and is shown vs. the total generating capacity in Fig. 2. For these schemes the values of reactance were assumed as shown on Fig. 1. Motor loads and short circuit contributions therefrom were neglected. The right hand ordinate of Fig. 2 shows the kva interrupting duty for standard ratings of oil circuit breakers used in metal-clad switchgear. Oil circuit breakers only are listed although air circuit breakers are available. If a corrosive atmosphere prevails, as it often does in a refinery, the oil circuit breaker is preferable.

The results shown in Fig. 2 illustrate the benefits gained in limiting short circuit duty through the use of current limiting reactors for different arrangements. While the simplest scheme, shown by arrangement *A*, has all generators on a single bus, the limitations imposed by available circuit breaker ratings are exceeded for low total generating capacity, even at the higher voltage of 13.8 kv. Equally satisfactory schemes are obtained through the use of reactors such as in *B*, *C*, *D*, or *E*. Generally speaking it will almost always be found that a synchronizing bus provides the most effective use of reactors to limit short circuit duty.

The data of Fig. 2 can be plotted in terms of short circuit current (instead of kva) vs generating capacity, as shown in Fig. 3 for arrangement *A*. For any given generating capacity and resultant short circuit kva, the short circuit current is dependent upon the system voltage. When the circuit breaker ratings are interpreted in terms of maximum interrupting current at the particular voltage, the limits of generating capacity at that voltage for a given breaker are easily visualized.

For example, using an F-100 breaker, the maximum generating capacity is 8000 kva at 2.4 kv, 4.16 kv or 6.9 kv. For a B-20-B breaker it is 7200 kva at 2.4 kv and 12,000 kva at 4.16 kv; 6.9 kv and 13.8 kv. The B-20-B, B-22-B and B-28-B breakers are 13.8 kv breakers but may be used on lower voltage service as long as current interrupting limits are not exceeded. Fig. 3 might be repeated for some of the other arrangements. Its main purpose however is to illustrate circuit breaker limitations which often dictate the voltage of the generating source or the incoming utility circuit.

Two other schemes are illustrated in Fig. 1, namely *F* and *G* which are the ring bus and the mutual reactor. The ring bus will have about the same interrupting duty (slightly higher) as scheme *C* but may have some operating advantage because of the use of a closed ring. This operating advantage comes about during emergency operation with one generator out of service. In the case of a ring bus, with one generator down, power is supplied to this bus from each adjacent bus through the reactors.

In the case of scheme *C*, if a generator is down at either end of the bus, all power must be transferred over the bus tie reactor from an adjacent bus. In either of the schemes, *C* and *F*, breakers can be used to by-pass a reactor for emergency operation. Such use increases the switchgear cost in the generating station but provides better voltage conditions by eliminating power current flow through the reactor. Some complication is added in switching procedures.

The mutual reactor has not been used to any great extent but is a satisfactory scheme. Each case is best analyzed on its own merits. In general the major precautions which must be taken in design is to limit induced voltage on one side of the reactor with fault current flowing from the generator through the other side of the reactor.

Schemes *D* or *E* can utilize bypassing circuit breakers on the synchronizing bus reactors for emergency

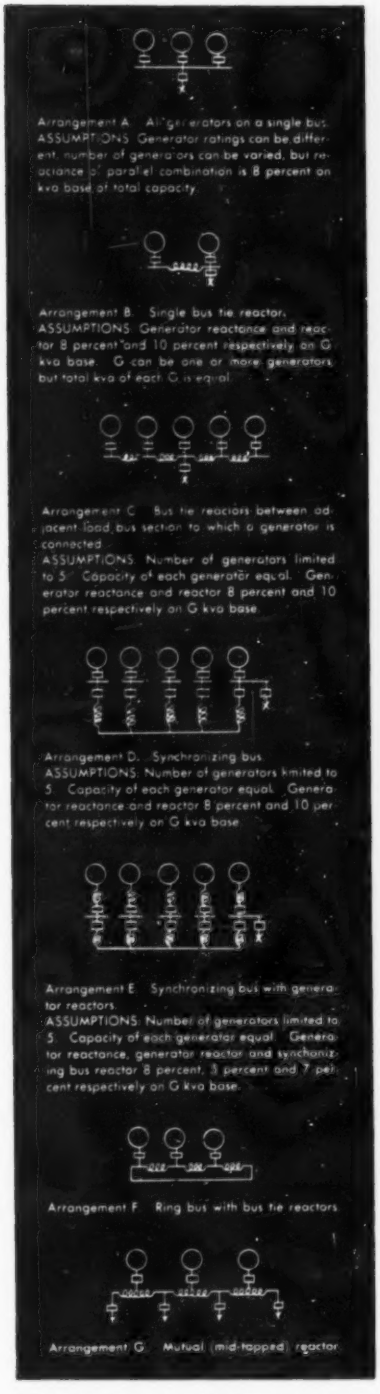
Arrangement A. All generators on a single bus.
ASSUMPTIONS: Generator ratings can be different, number of generators can be varied, but reactance of parallel combination is 8 percent on kva base of total capacity.
Arrangement B. Single bus tie reactor.
ASSUMPTIONS: Generator reactance and reactor 8 percent and 10 percent respectively on G kva base. G can be one or more generators but total kva of each G is equal.
Arrangement C. Bus tie reactors between adjacent load bus section to which a generator is connected.
ASSUMPTIONS: Number of generators limited to 5. Capacity of each generator equal. Generator reactance and reactor 8 percent and 10 percent respectively on G kva base.
Arrangement D. Synchronizing bus.
ASSUMPTIONS: Number of generators limited to 5. Capacity of each generator equal. Generator reactance and reactor 8 percent and 10 percent respectively on G kva base.
Arrangement E. Synchronizing bus with generator reactors.
ASSUMPTIONS: Number of generators limited to 5. Capacity of each generator equal. Generator reactance, generator reactor and synchronizing bus reactor 8 percent, 3 percent and 7 percent respectively on G kva base.
Arrangement F. Ring bus with bus tie reactors.
Arrangement G. Mutual (mid-tapped) reactor.

FIG. 1—Generator station bussing arrangements (Assumptions refer to calculations for results for Figs. 2 and 3)

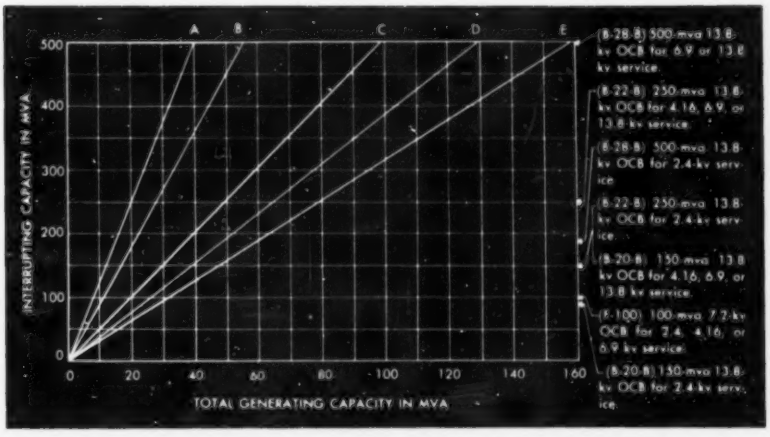

FIG. 2—Interrupting capacity vs. total generation for arrangements A, B, C, D, and E of Fig. 1

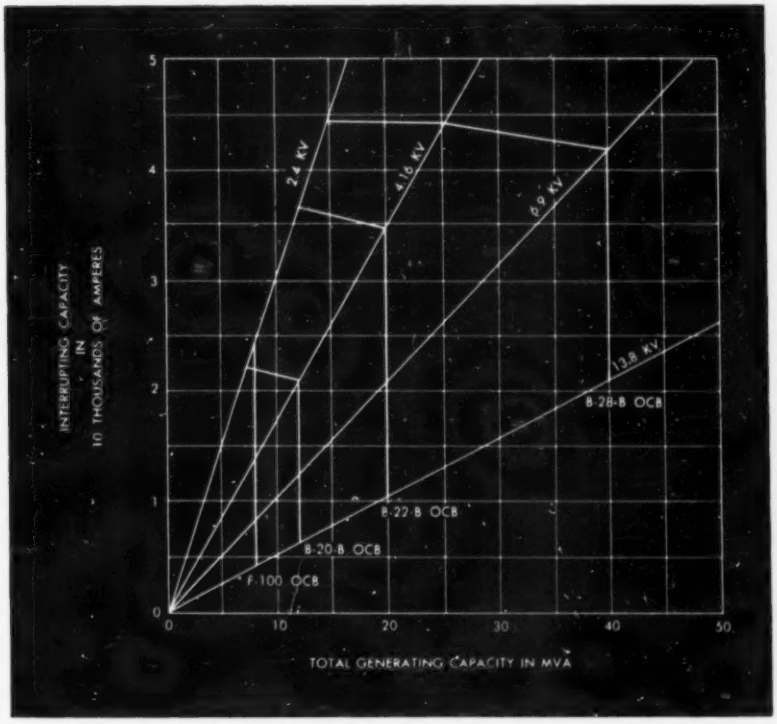

FIG. 3—Interrupting capacity in amps. vs. total generating capacity for Curve A of Fig. 2 (Arrangement A of Fig. 1)

operating conditions. The advantages and disadvantages are similar to those discussed for schemes *C* and *F* above.

In some refineries there may be more than one source of power, maybe two or three power plants. Oftentimes a synchronizing bus arrangement is used. In tying two plants together or in bringing in a utility tie the question frequently arises as to whether or not it is best to connect the tie lines to the synchronizing bus or to one of the load bus sections.

This question is difficult to answer because of the peculiarities of each case. Some case studies have shown each scheme to have merits in limiting interrupting duty. Generally speaking, it appears fundamental to consider a tie line as a power source, which would be connected to a load bus section.

The service continuity to any electrical load in a refinery or industrial plant is only as good as the reliability of the power source and the main and alternate or dual feeds to that load. Whether or not single or double bus type of switchgear is best depends upon an evaluation by the refinery management of complete loss of power and consequent loss of production vs incremental switchgear costs. Many standard arrangements are available in metal-clad switchgear. It seems unlikely that a single bus arrangement would provide sufficient reliability for an electrical load in an oil refinery and for this reason an alternate arrangement of main and transfer, double bus-double break-

Table 1—Comparison of Individual Characteristics of Ten Basic Systems

Type of Distribution System	Flexibility	Service Continuity	Regulation	Efficiency	Operation & Maint. Cost	Initial Investment
1. Conventional Simple-Radial	C	E	F	E	A	D
2. Modern Simple-Radial	F	F	D	C	A	A
3. Loop-Primary Radial	D	E	D	B	A	A
4. Banked-Secondary Radial	A	C	B	A	B	D
5. Primary-Selective Radial	D	D	D	B	A	B
6. Secondary-Selective Radial	D	B	B	D	D	D
7. Simple-Network	A	A	A	C	B	E
8. Simple Spot-Network	C	A	A	D	D	E
9. Primary-Selective Network	A	A	B	A	C	D
10. Primary-Selective-Spot Network	C	A	B	A	D	D

Table 2—Weighting of System Characteristics

	Flexibility	Service Continuity	Regulation	Efficiency	Operation & Maint. Cost	Initial Investment
Normal Weighting Factors	3	2	1	1	1	6
Percent	21.5	14.3	7.1	7.1	7.1	42.9
I. Weighting Factors	6	2	1	1	1	6
Percent	35.3	11.7	5.9	5.9	5.9	35.3
II. Weighting Factors	3	4	1	1	1	6
Percent	18.8	25.0	6.3	6.3	6.3	37.3
III. Weighting Factors	3	2	1	1	1	12
Percent	15.0	10.0	5.0	5.0	5.0	60.0
IV. Weighting Factors	6	4	1	1	1	9
Percent	27.2	18.3	4.5	4.5	4.5	41.0

Table 3—Comparison of Systems Based on Assigned Weightings Shown in Table 2

Type of Distribution System	—Weighting Factors—(From Table 2)— "Normal"	I	II	III	IV
1. Conventional Simple Radial	D	D	D	D	D
2. Modern Simple Radial	C	D+	D+	C+	C+
3. Loop Primary Radial	C+	C	C	B	C+
4. Banked Secondary Radial	C+	B—	C+	C	C+
5. Primary Selective Radial	C	C	C	C+	C
6. Secondary Selective Radial	D+	D+	C—	D+	D+
7. Simple Network	C+	C+	C+	D+	C
8. Simple Spot Network	D+	D+	C—	D	D+
9. Primary Selective Network	C+	B—	B—	C	B—
10. Primary Selective Spot Network	C	C	C+	C—	C

Gradings	
A+	98-100
A	94-97
A—	91-93
B+	88-90
B	84-87
B—	81-83
C+	78-80
C	74-77
C—	71-73
D+	68-70
D	64-67
D—	61-63
E	51-60
F	41-50

er, double bus-single breaker is considered best.

Problems of Distribution

The electrical distribution system in the modern oil refinery has been an ever-expanding link between the power source and the growing electrical load. In addition to lighting, as much as two-thirds of the motive power needs of the present day refinery are supplied by electric motor drives. Pumps, for cooling water and for oil and its products in the process stream, compressors, agitators, mixers, dehydrators, materials handling equipment—these have all contributed to the growth of the load on the electrical distribution system.

The continuous nature of the refinery processes, with often no more than one annual shutdown for maintenance, demands the utmost reliability of whatever means are used to power the plant. In the past this has been an objection to the large scale utilization of electric motor driven equipment in the refinery. Improvements in motor designs to meet the requirements of hazardous and corrosive atmospheres have helped greatly to overcome the problem of reliability as well as that of safety.

The need for reliable and substantially uninterrupted service, where process unit operation depends solely on electrical drives, must include the distribution system and the electric power source itself.

Along with reliability another important requirement of the refinery electrical system is flexibility.

The competitiveness of the business, reflected in the continual development of new processes and methods, calls for relatively short term financing of new plant construction or modernization as compared to many other types of plants. While this means that the dollars invested in refinery plant, including distribution system investment are scrutinized with a cold eye, it also means that a system with inherent flexibility to handle a changing and growing load is of great importance.

Selecting System Voltages

An important step in planning a new system and often a part of planning the expansion of an existing system is the consideration of voltage levels to be used. The choice of voltage both at the primary level and at the utilization voltage level may appreciably affect the arrangement of the distribution system.

The problem of what voltages should be used is largely one of economics. In the primary voltage range, major items whose costs enter into the choice are primary feeder switchgear at the plant power source, and the primary feeder circuits themselves. The cost of circuit breakers controlling the primary feeders varies widely with the system voltage. The economical use of circuit breakers at 2400 volts is limited to interrupting duties not exceeding 183,000 kva and at 4160 volts to 250,000 kva and below. This means that for plant loads beyond about 10,000 kva primary feeder switchgear cost may be excessive at the lower voltages.

The cost of primary feeder circuits is, in general, considerably reduced at the higher system voltages. Lower current requirements or greater circuit loading within permissible voltage regulation limits is responsible for this. Taken together, the cost of primary feeder circuits and their switchgear is a major factor favoring the higher primary voltages such as those in the 15 kv class.

The possibility of supplying the larger units of motor load directly from the primary system and the attendant saving of step-down transformer capacity may appear to favor a low primary voltage. A voltage of 2400 volts is most favorable from this standpoint alone, since the cost of motors and control at 2400 volts is substantially less than at higher voltages.

However, the savings in step-down capacity or in motor and control cost must more than offset the increased cost of the primary feeder circuits and switchgear in order to justify the lower primary voltage. It appears that a large portion of the total plant load, possibly 50% or more, must consist of motors larger than 200 hp. before this offset point is reached. This will of course vary greatly with the amount of plant load considered. The larger the plant load and the larger the motor sizes considered, the greater percentage of large motor load necessary to justify the low primary voltages on this basis.

The voltage of the utility supply to the plant is often a factor in choosing the primary voltage of the distribution system. When the utility supply voltage is higher than 15 kv, step-down transformer capacity is necessary to provide a primary voltage below 15 kv. The cost of this step-down capacity is about the same for any of the common primary voltages so that its cost has little or no influence on the voltage choice. However, where the supply voltage is below 15 kv, the saving of the cost of step-down capacity will often justify making the primary voltage the same as the incoming supply voltage.

The choice of the secondary or util-

ization voltage depends largely on these major factors: 1) Secondary substation cost; 2) Low voltage feeder circuit cost; and, 3) Motor and control cost.

For a given type of secondary substation the cost per kva of substation capacity at different secondary voltages depends to a great extent on how large the substation is and what size low voltage circuit breakers are required. In general the cost of 460-volt substations is appreciably lower than 208 volt substations. The difference in substation cost at these two secondary voltages increases for large substation sizes where the interrupting duty becomes the determining factor in the size of low voltage breakers required. In many cases low voltage switchgear will represent from 40 to 60% of the investment in secondary substations. Since for a given size substation both interrupting duty and total current rating are less than half at 460 volts than at 208 volts, lower cost breakers contribute greatly to the overall lower cost of 460 volt substations.

Low voltage feeder circuit costs also usually favor the higher secondary voltage. A smaller conductor size for a given load along with lower I^2R losses is responsible for this.

The other factor influencing the choice of utilization voltage is the cost of motors and control. For motors alone, in sizes up to 200 hp., costs are similar for 208, 220, 440 and 550-volt ratings. Introducing the cost of control, however, makes the 208 and 220-volt ratings the more expensive except for the very small ratings up to about 10 hp.

The use of two utilization voltages is common in many refineries where the larger units of motor load are supplied at a voltage above 600 volts. If the system primary voltage is above the 4 kv class a step-down to 2400 volts for these large motors is likely to be justified. If the primary voltage is in or below the 4 kv class, the large motor load can be supplied at the same voltage avoiding the cost of step-down transformer capacity. In either case, two utilization voltages are employed, one above and one below 600 volts.

Distribution System Arrangement

In developing a plan for the arrangement of circuits and equipment making up the distribution system there are, in general, ten basic forms to be considered. However, in a specific type of plant such as the petroleum refinery the inherent requirements of the load to be served will eliminate several of these basic systems from further consideration. The principal requirements of refinery electrical load have been previously discussed. It remains to show the effect of these requirements on the selection of a distribution system arrangement.

Table 1 shows the results of a comparison of the characteristics of the ten major forms of industrial distribution systems. In this table the individual characteristics of each system are not related to each other in terms of importance to a particular application. In order to compare the overall standing of the various systems for a particular type of plant, the characteristics used must be weighted according to their importance in meeting the plant's requirements.

Table 2 shows various weighting factors which were considered and the corresponding percent weight given to each system characteristic. It will be noticed that the first set of factors is designated as being for a "normal" plant. It is of course recognized that there is probably no such thing as a normal plant.

Each of the next three groups of weighting factors are the same as those of the normal plant except that the importance of one of the three characteristics, flexibility, service continuity and initial investment, is emphasized by doubling its weighting factor. In the last set of factors all three of these characteristics, which are considered of more than usual importance to the refinery installation, have been given more weight than that considered for the "normal" plant. In order to show that service continuity and flexibility in the refinery distribution system may be considered of relatively greater importance, compared to initial investment, than was considered in the normal plant, the weighting of initial investment was increased by 50%. The weightings of flexibility and service continuity were increased by 100%.

Table 3 gives the comparative standings of the ten system arrangements based on the weighting factors of Table 2. It is shown that seven of the ten basic systems appear to be most applicable for the so-called normal plant. When the systems are compared in terms of requirements of the refinery six of the ten systems have a rating of C or higher. For the particular weighting factors assumed, the numerical gradings show that three of these six systems are the highest rated. These three systems are: 1) The Loop Primary Radial System; 2) The Banked Secondary Radial System; and, 3) The Primary Selective Network System.

In making a final choice of system arrangement for a particular refinery installation there will likely be many local factors to be considered. In addition it is inevitable that the importance of the various distribution system characteristics will vary among refineries and operators. However it is felt that by applying weighting factors appropriate to the particular conditions, the choice can be narrowed down to two or three of the basic arrangments and thus furnish the planning engineer with a guide to obtaining the best system for the job.

Acknowledgement

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Meet the Authors

Mr. Lawrence

R. F. Lawrence, an electric utility engineer with Westinghouse Electric Corp., has been with the company since 1943 when he was graduated from Pratt Institute's school of electrical engineering. He has been concerned with problems dealing with the application of equipment for the generation, transmission, and distribution of electric power.

Mr. Thacker

For the past six years, Mr. Lawrence has been assigned to the Southwestern district where his work has brought him into close contact with the petroleum industry. He is also a lecturer at the University of Pittsburgh in the Westinghouse graduate study program.

H. B. Thacker, a distribution engineer in Westinghouse's electric utility engrg. dept., has been with the firm since 1946, when he left the U. S. Army Signal Corps after three years' service. Born in New Castle, Penna. in 1919, Mr. Thacker received his B.S. in electrical engrg. from Penn State in 1941, and worked for Pennsylvania Power Co. and Youngstown Sheet & Tube Co. before entering military service.

How to Apply Method of Slope Deflection To Thermal Stress Analysis of Piping

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SAFE and economical piping designs for refinery and petrochemical processing installations are requiring increasingly accurate stress analyses of all or part of each system. Pressures and temperatures in new processes are continually on the upgrade; safety requirements are getting more severe; the cost of piping materials is increasing.

All of these factors dictate that greater attention will have to be paid to the design of this part of the plant.

Toward this end, more extensive analysis of piping systems seems to be in order, perhaps through the use of some of methods for solution of indeterminate structures familiar to the structural and mechanical engineer. One such method which lends itself to the analysis of piping systems and deserves consideration is the method of slope deflection.

This method is proposed as a reasonable solution for most single plane piping systems. Its advantages over most of the commonly employed methods lies in its adaptation to:

1. Systems having more than two anchor points.
2. Systems having branch lines connected to a main.
3. Systems having yielding supports.
4. Systems having members of different pipe diameters and moments of inertia.
5. Systems where "Cold Springing" or pre-stressing is desirable.

Systems analyzed in this manner and with the resulting stresses in curved sections modified by the β factor of Professor W. Hovgaard[1] yield sufficiently close results on the safe side.[2]

Most of the analysis methods commonly in use at present do not provide for the effects of all of the conditions listed above.

The following is a brief explanation of the method and two examples of its use. Example I is a demonstration of the method applied to a simple 90° "L" Bend, fixed at both ends. It offers a review of the theory and computing method for this very common shape. Example II demonstrates the method applied to a more complicated system containing three anchor points and members of different diameter pipe.

The basic slope deflection equation[3] may be expressed as follows:

$$M_{NF} = \frac{2EI}{L}(2\theta_N + \theta_F - 3\phi_{NF}) + F.E.M._{NF} \qquad (A)$$

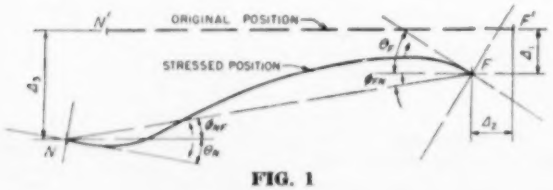


FIG. 1

Where:

M_{NF} = Moment applied to the "N" end of member NF.
θ = The rotation of the tangent to the elastic curve at the ends of the member referred to its original direction.
ϕ = Rotation of the chord of the elastic curve joining the ends of the member referred to its original position.
E = Modulus of elasticity of the material at operating temperature.
I = The moment of inertia of the pipe metal cross section.
L = The length of the member.
$F.E.M._{NF}$ = The fixed end moment at the "N" end of member NF.

NOTES:

a. Moments applied to the ends of members will be taken as positive when acting clockwise.
b. Rotation ϕ will be taken as positive when the chord of the elastic curve has rotated clockwise from its original position.
c. Rotation θ will be taken as positive when the tangent

Meet the Author

Mr. Picardi

E. Alfred Picardi graduated from the Massachusetts Institute of Technology with the Degree of B. S. in Civil Engineering, and is registered as a Professional Engineer in Massachusetts and Ohio. He was employed as a Structural Designer for E. B. Badger & Sons Co., and Structural Engineer for Swift & Co. and the Morton C. Tuttle Co. of Boston. As Structural Engineer for the Crandall Engineering Co. of Boston, he was responsible for analysis of indeterminate structures for the main spans of the Long Island Viaduct over Boston Harbor. He has done considerable work on design of special types of prefabricated buildings for the Armed Forces while associated with the Craig Machine Corporation of Danvers, Mass.

During World War II, Mr. Picardi served first in the U. S. Army Corps of Engineers and later as a member of the Office of Scientific Research & Development. He was attached to the Office of the Chief of Naval Operations as a member of the Operations Research Group, where he applied engineering knowledge and experience to naval operations technique.

At present, Mr. Picardi is Chief Structural Engineer of the Chemical & Refinery Division of Kaighin & Hughes, Inc., Toledo, Ohio.

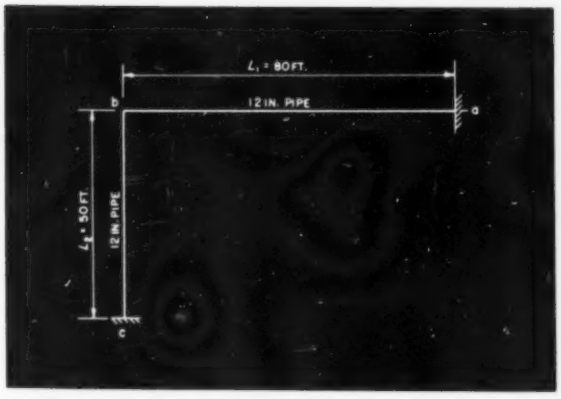


FIG. 2—Layout of piping for Example I

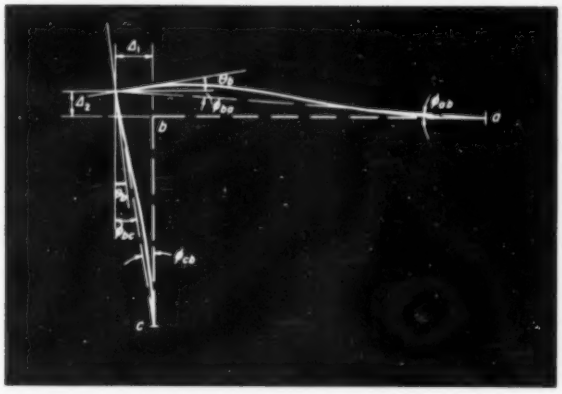


FIG. 3—Elastic curve, Example I

to the elastic curve has rotated clockwise from its original position.

d. The fixed end moments are those moments which would occur at the ends of the member due to external loading if these ends were fixed. They may be determined for any given loading of a member by use of the formulas for moments at the ends of fixed end beams. In general piping problems external loads are not applied to the pipe system and therefore the fixed end moments are zero.

For any given pipe structure we may write the expression (Equation A) for the moments applied to the ends of each member. These equations, together with the equations of statics, permit solving for the unknown moments at each joint of the structure. We may then construct a bending moment diagram and compute the reactions at anchor points.

Bending stresses at any point may be computed from the moment at that point in the usual manner.

EXAMPLE I

Stress analysis of a 90° "L" Bend, shown in Fig. 2, by application of the slope deflection method.

Given:

90° Bend, both ends fixed.—12 in. Sch. 80 Pipe
ASTM Spec. A-106
Steam Temperature, 700° F.—Pressure, 650 psi.
E @ 700° F. = 25 × 10.6 psi.
Expansion = 5.75 in. per 100 ft.
Flow Area = 101.6 sq. in.
Metal Area = 26.04 sq. in.
Moment of inertia = 475 in.^{4}
Section Modulus = 74.5 in.^{3}
Allowable combined stress = 0.75 (9100 + 9600)
= 14025 psi.
$\Delta_1 = (5.75 \times 80)/100 = 4.5$ inches
$\Delta_2 = (5.75 \times 50)/100 = 2.88$ inches

Starting with the basic slope deflection equation

$$M_{NF} = \frac{2EI}{L}(2\theta_N + \theta_F - 3\phi_{NF}) + F.E.M._{NF} \quad \text{(A)}$$

the following slope deflection equations may be written for the elastic curve in Fig. 3:

$$M_{AB} = \frac{2EI_1}{L_1}(2\theta_A + \theta_B - 3\phi_{AB}) + F.E.M._{AB} \quad (1)$$

$$M_{BA} = \frac{2EI_1}{L_1}(2\theta_B + \theta_A - 3\phi_{BA}) + F.E.M._{BA} \quad (2)$$

$$M_{BC} = \frac{2EI_2}{L_2}(2\theta_B + \theta_C - 3\phi_{BC}) + F.E.M._{BC} \quad (3)$$

$$M_{CB} = \frac{2EI_2}{L_2}(2\theta_C + \theta_B - 3\phi_{CB}) + F.E.M._{CB} \quad (4)$$

Computing the Bending Moment Curves

Assuming no external forces acting on the pipe and neglecting the minor effect of bending stresses due to the weight of the pipe between hangers, we will concern ourselves only with the thermal stresses. Thus all fixed end moments may be omitted from Equations 1, 2, 3 and 4. Further, from inspection of the elastic curve, Fig. 3, we find:

$$\theta_A = 0 \qquad \phi_{AB} = \phi_{BA}$$

$$\theta_C = 0 \qquad \phi_{BC} = \phi_{CB}$$

Also,

$$M_{BA} = -M_{BC} \quad (5)$$

may be written for equilibrium at Joint "B".

Thus, Equations 1 through 4 may be rewritten as follows:

$$M_{AB} = \frac{2EI_1}{L_1}(\theta_B - 3\phi_{AB}) \quad (1)$$

$$M_{BA} = \frac{2EI_1}{L_1}(2\theta_B - 3\phi_{BA}) \quad (2)$$

$$M_{BC} = \frac{2EI_2}{L_2}(2\theta_B - 3\phi_{BC}) \quad (3)$$

$$M_{CB} = \frac{2EI_2}{L_2}(\theta_B - 3\phi_{CB}) \quad (4)$$

From data based on the design conditions we may compute values for known terms of these equations as follows:

$$\frac{2I_1}{L_1} = K_1 = \frac{(2)(475)}{(12)(80)} = 0.990$$

$$\frac{2I_2}{L_2} = K_2 = \frac{(2)(475)}{(12)(50)} = 1.583$$

$$\phi_{AB} = \phi_{BA} = \frac{\Delta_2}{L_1} = \frac{2.88}{(80)(12)} = +0.00300$$

$$\phi_{BC} = \phi_{CB} = \frac{\Delta_1}{L_2} = \frac{4.60}{(50)(12)} = -0.00767$$

Substituting these values in Equations 1 through 4 and simplifying, they become:

$$M_{AB} = EK_1(\theta_B - 0.009) = EK_1\theta_B - 0.009\,EK_1 \quad (1)$$

$$M_{BA} = EK_1(2\theta_B - 0.009) = 2EK_1\theta_B - 0.009\,EK_1 \quad (2)$$

$$M_{BC} = EK_2(2\theta_B + 0.02301) = 2EK_2\theta_B + 0.02301\,EK_2 \quad (3)$$

$$M_{CB} = EK_2(\theta_B + 0.02301) = EK_2\theta_B + 0.02301\,EK_2 \quad (4)$$

Using Equation 5, $M_{BA} = -M_{BC}$, we may put Equation 2 = Equation 3 and solve for θ_B thus:

$$2EK_1\theta_B - 0.009\,EK_1 = -2EK_2\,\theta_B - 0.02301\,EK_2$$

$$2K_1\,\theta_B + 2K_2\theta_B = 0.009K_1 - 0.02301\,K_2$$

$$5.146\,\theta_B = 0.00891 - 0.03642 = -0.02751$$

$$\theta_B = -0.00535$$

Substituting -0.00535 for θ_B in Equations 1 through 4 we may solve for the moments as follows:

$M_{AB} = -29600$ ft. lbs. ..... (1)

$M_{BA} = -40600$ ft. lbs. ..... (2)

$M_{BC} = +40600$ ft. lbs. ..... (3)

$M_{CB} = +58200$ ft. lbs. ..... (4)

The Bending Moment Diagram

Having computed the moments applied to the ends of the members at each joint we may construct the bending moment diagram, Fig. 4. It should be noted that the signs of the moments computed in Equations 1 through 4 refer only to whether the moments applied at the ends of the members act in a clockwise or counter clockwise direction. However, in Fig. 4 we have used a system showing as positive those bending moments which cause tension stress on the interior edges of the "L" and as negative those bending moments which cause tension stress on the exterior edges of the "L".

Computing the Anchor Thrusts

The thrust line is constructed on Fig. 4 through the points of inflection on the bending moment curves. These are the points of zero moments. The reaction at "*A*" is found by dividing the bending moment at "*A*" by the perpendicular distance from "*A*" to the thrust line. Likewise, the reaction at "*C*" which should be equal and opposite the reaction at "*A*" is found by dividing the bending moment at "*C*" by the perpendicular distance from "*C*" to the thrust line. The reactions at "*A*" and "*C*" act parallel to the thrust line.

Computing the Bending Stresses

The bending stress in any section of straight pipe can be computed in the usual manner by dividing the moment at that section by the section modulus of the pipe, ie, $f_b = M/Z$. In that portion of the system containing curved sections the stress distribution is modified by flattening of the cross section during bending. The basic bending stress formula $f_b = M/Z$ should be modified by multiplying by the stress coefficient β,[1] ie, $f_b = \beta\,M/Z$, where

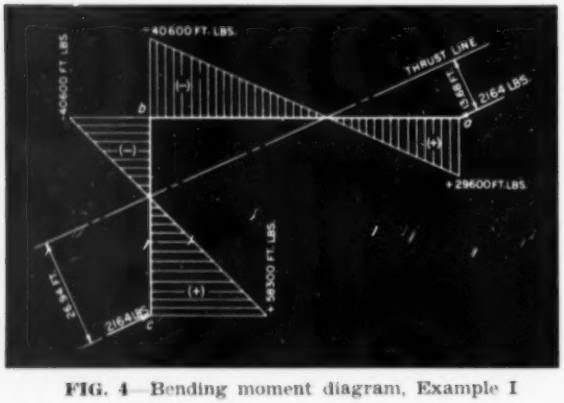


FIG. 4—Bending moment diagram, Example I

Table 1—Evaluation of Constants in Example II

Member	I in.^{4}	L in.	$K = \frac{2I}{L}$	$\phi = \frac{\Delta}{L}$	Pipe Size Dia.	Sch.	Z in.^{3}
AB	160.8	480	0.6700	+0.003594	10"	40	29.9
BA	160.8	480	0.6700	+0.003594	10"	40	29.9
BC	72.5	600	0.2417	+0.002875	8"	40	16.81
CB	72.5	600	0.2417	+0.002875	8"	40	16.81
BE	28.1	360	0.1561	−0.006389	6"	40	8.50
EB	28.1	360	0.1561	−0.006389	6"	40	8.50
CD	72.5	720	0.2014	−0.007188	8"	40	16.81
DC	72.5	720	0.2014	−0.007188	8"	40	16.81

Temperature—700° F.
Pressure—650 psi.
Expansion—5.75 in./100 ft.
$E = 25\times10^6$ psi. at 700° F.
Pipe Spec. A-106-B

$\Delta_1 = 5.75\times0.90 = 5.175$
$\Delta_2 = 5.75\times0.40 = 2.300$
$\Delta_3 = 5.75\times0.30 = 1.725$
$\Delta_4 = 5.75\times0.60 = 3.450$
$\Delta_5 = \Delta_4 - \Delta_3 = 1.725$

$$\beta = \frac{12\,\lambda^2 - 2}{12\,\lambda^2 + 1}, \text{ for values of } \lambda > 1.25,$$

and

$$\beta = \frac{2}{3}K\sqrt{\frac{6\,\lambda^2 + 5}{18}}, \text{ for values of } \lambda < 1.25$$

In the above formulas:

$$\lambda = \frac{tR}{r^2} \quad \text{and} \quad K = \frac{12\,\lambda^2 + 10}{12\,\lambda^2 + 1}$$

Where:

t = wall thickness of pipe,
r = mean radius of metal cross section,
R = radius of bend.

Thus, the bending stress at the bend point B in Example I is computed as follows:

Assume a bend radius of 60"

$$f_b = \beta\frac{M_B}{Z} = 0.8172 \times \frac{(40600)(12)}{74.5} = 5344 \text{ psi.}$$

Where:

$$\beta = \frac{12\,\lambda^2 - 2}{12\,\lambda^2 + 1} = 0.8172$$

$$\lambda = \frac{t\,R}{r^2} = \frac{(0.687)(60)}{6.0312} = 1.133$$

$t = 0.687$ in.
$R = 60$ in.
$r = 6.031$ in.
$Z = 74.5$ in.^{3}
$M_B = 40600$ ft. lbs.
f_b = bending stress in the bend.

To this bending stress we must add the pressure stress

$$f_p = \frac{PA_f}{A/_m} = \frac{(650)(101.5)}{26.04} = 2534 \text{ psi.}$$

Where:

p = internal operating pressure,
A_f = flow area of pipe,
A_m = cross section area of metal,
f_p = stress due to internal pressure.

the combined bending and pressure stress at point B will be:

$$f_t = f_b + f_p = 7878 \text{ psi.}$$

Assuming that an 18-in. radius bend is to be used instead of the 60-in. bend, the bending stress is computed as follows:

$$\lambda = \frac{tR}{r^2} = \frac{(0.687)(18)}{6.031^2} = 0.339$$

$$K = \frac{12\lambda^2 + 10}{12\lambda^2 + 1} = 4.78$$

$$\beta = \frac{2}{3} K \sqrt{\frac{6\lambda^2 + 5}{18}} = \frac{2}{3}(4.78)\sqrt{\frac{(6)(0.115) + 5}{18}} = 1.79$$

$$f_b = \beta \frac{M_B}{Z} = 1.79 \times \frac{(40600)(12)}{74.5} = 11700 \text{ psi.}$$

Where:

$t = 0.687$ in.
$R = 18$ in.
$r = 6.031$ in.
$Z = 74.5$ in.^{3}
$M_B = 40600$ ft. lbs.
$f_b =$ bending stress in bend

The combined bending and pressure stress in this case would be

$$f_t = f_b + f_p = 11700 + 2534 = 14234 \text{ psi.}$$

EXAMPLE II

Stress analysis, by application of the slope deflection method, of a more complicated system containing three anchor points and members of different diameter pipe, shown in Fig. 5.

In this case, computation may be facilitated by use of a tabular method for evaluation of constants (Table 1) and a sketch of the elastic curve, Fig. 6.

Slope deflection equations may be written for the ends of each member as follows:

$$M_{AB} = \frac{2EI_1}{L_1}(2\theta_A + \theta_B - 3\phi_{AB}) + F.E.M._{AB} \quad (1a)$$

$$M_{BA} = \frac{2EI_1}{L_1}(2\theta_B + \theta_A - 3\phi_{BA}) + F.E.M._{BA} \quad (2a)$$

$$M_{BE} = \frac{2EI_3}{L_3}(2\theta_B + \theta_E - 3\phi_{BE}) + F.E.M._{BE} \quad (3a)$$

$$M_{EB} = \frac{2EI_3}{L_3}(2\theta_E + \theta_B - 3\phi_{EB}) + F.E.M._{EB} \quad (4a)$$

$$M_{BC} = \frac{2EI_2}{L_2}(2\theta_B + \theta_C - 3\phi_{BC}) + F.E.M._{BC} \quad (5a)$$

$$M_{CB} = \frac{2EI_2}{L_2}(2\theta_C + \theta_B - 3\phi_{CB}) + F.E.M._{CB} \quad (6a)$$

$$M_{CD} = \frac{2EI_4}{L_4}(2\theta_C + \theta_D - 3\phi_{CD}) + F.E.M._{CD} \quad (7a)$$

$$M_{DC} = \frac{2EI_4}{L_4}(2\theta_D + \theta_C - 3\phi_{DC}) + F.E.M._{DC} \quad (8a)$$

Also:

$$M_{CD} = -M_{CB} \quad (9)$$

$$M_{BA} + M_{BC} + M_{BE} = 0 \quad (10)$$

But: all $F.E.M's. = 0$, $\theta_A = 0$, $\theta_E = 0$, and $\theta_D = 0$.
Therefore: Equations 1a through 8a may be rewritten as follows:

$$M_{AB} = EK_1(\theta_B - 3\phi_{AB}) \quad (1)$$

$$M_{BA} = EK_1(2\theta_B - 3\phi_{BA}) \quad (2)$$

$$M_{BE} = EK_3(2\theta_B - 3\phi_{BE}) \quad (3)$$

$$M_{EB} = EK_3(\theta_B - 3\phi_{EB}) \quad (4)$$

$$M_{BC} = EK_2(2\theta_B + \theta_C - 3\phi_{BC}) \quad (5)$$

$$M_{CB} = EK_2(2\theta_C + \theta_B - 3\phi_{CB}) \quad (6)$$

$$M_{CD} = EK_4(2\theta_C - 3\phi_{CD}) \quad (7)$$

$$M_{DC} = EK_4(\theta_C - 3\phi_{DC}) \quad (8)$$

From Equation 9 ($M_{CB} = -M_{CB}$), Equations 6 and 7 may be combined, solving for θ_C in terms of θ_B by substituting for known terms, as follows:

$$EK_4(2\theta_C - 3\phi_{CD}) = -EK_2(2\theta_C + \theta_B - 3\phi_{CB})$$

$$0.2014E(2\theta_C + 0.021564) = -0.2417E(2\theta_C + \theta_B - 0.008625)$$

$$E(0.4028\theta_C + 0.004343) = E(-0.4834\theta_C - 0.2417\theta_B + 0.002084)$$

$$0.886_2\theta_C = -0.2417\theta_B - 0.002259$$

$$\theta_C = -0.2727\theta_B - 0.002549 \quad (9a)$$

From Equation 10 ($M_{BA} + M_{BC} + M_{BE} = 0$), we combine Equations 2, 5 and 3, solving for θ_B by substituting for known terms and for θ_C in terms of θ_B:

$$EK_1(2\theta_B - 3\phi_{BA}) + EK_2(2\theta_B + \theta_C - 3\phi_{BC}) + EK_3(2\theta_B - 3\phi_{BE}) = 0$$

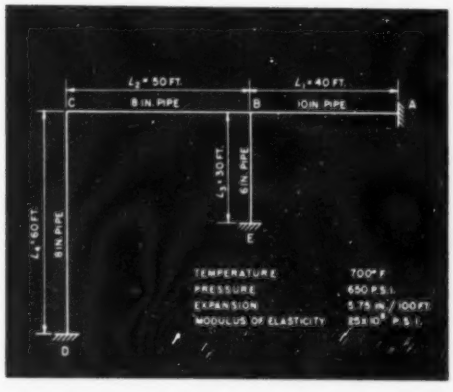


FIG. 5—(above)—Layout of piping for Example II

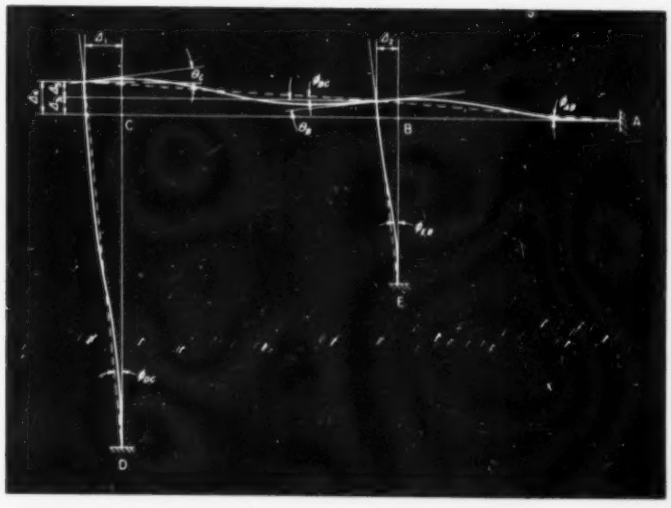


FIG. 6—(right)—Elastic curve, Example II

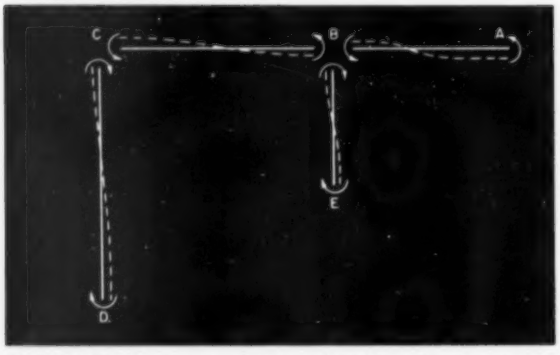


FIG. 7—Elastic curve, showing direction of end moments on isolated members, Example II

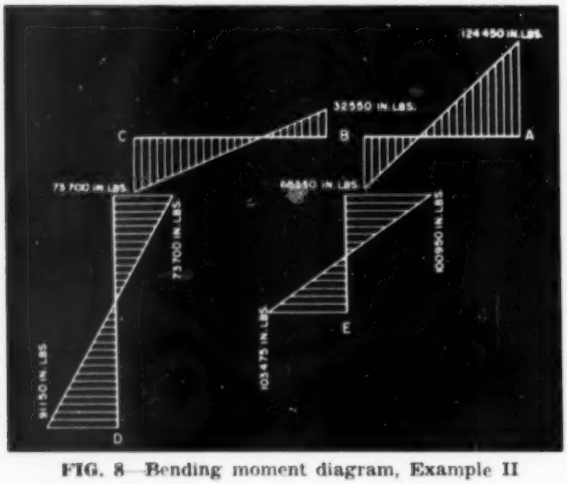


FIG. 8—Bending moment diagram, Example II

$$0.6700\ E\ (2\theta_B - 0.01078) + 0.2417\ E\ (2\theta_B + \theta_C - 0.008625) + 0.1561\ E\ (2\theta_B + 0.019167) = 0$$

$$1.340\ \theta_B - 0.007226 + 0.4834\ \theta_B + 0.2417\ \theta_C - 0.002085 + 0.3122\ \theta_B + 0.002992 = 0$$

$$2.1356\ \theta_B - 0.006319 + 0.2417\ \theta_C = 0$$

$$2.1356\ \theta_B - 0.006319 + 0.2417\ (-0.2727\ \theta_B - 0.002549) = 0$$

$$2.1356\ \theta_B - 0.006319 - 0.06591\ \theta_B - 0.00061609 = 0$$

$$2.0697\ \theta_B = 0.0069351$$

$$\theta_B = 0.003351$$

Having solved for θ_B we may solve for θ_C by substitution in Equation 9a:

$$\theta_C = -0.2727\ \theta_B - 0.002549$$

$$\theta_C = -0.0009138 - 0.002549$$

$$\theta_C = -0.003463$$

Substituting in Equations 1 through 8 all known values and computed values for θ_B and θ_C we may solve for all moments applied at the ends of each member. Results are as follows:

$$M_{AB} = EK_1\ (\theta_B - 3\phi_{AB}) = -0.004978\ E$$
$$= -124450 \text{ in. lbs.}$$

$$M_{BA} = EK_1\ (2\theta_B - 3\phi_{BA}) = -0.002734\ E$$
$$= -68350 \text{ in. lbs.}$$

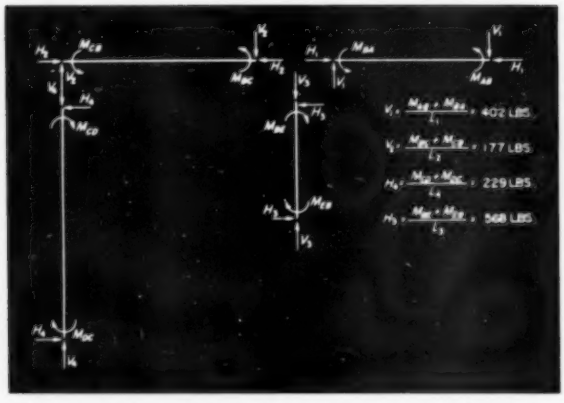


FIG. 9—Designations for forces and moments acting on the ends of isolated members, Example II

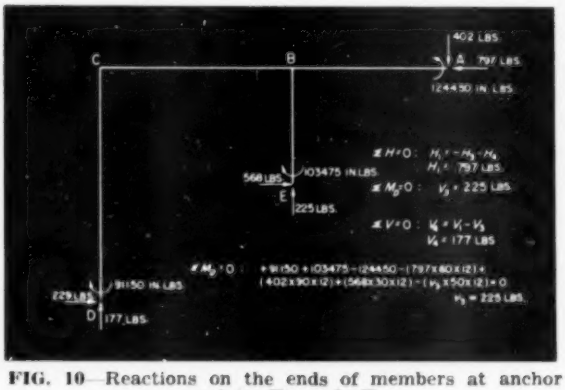

402 LBS.
C
B
A 797 LBS.
124450 IN. LBS.
568 LBS.
103475 IN. LBS.
E
225 LBS.
$\Sigma H = 0$: $H_1 = H_3 = H_4$
$H_1 = 797$ LBS.
$\Sigma M_D = 0$: $V_2 = 225$ LBS.
$\Sigma V = 0$: $V_1 = V_1 - V_2$
$V_1 = 177$ LBS
$\Sigma M_B = 0$: $+91150 + 103475 - (24450 - (797 \times 60 \times 12) + (402 \times 90 \times 12) + (568 \times 30 \times 12) - (V_3 \times 50 \times 12) = 0$
$V_3 = 225$ LBS.
229 LBS.
91150 IN. LBS.
D
177 LBS.

FIG. 10—Reactions on the ends of members at anchor points, Example II

$$M_{BE} = EK_3\ (2\theta_B - 3\phi_{BE}) = +0.004038\ E$$
$$= +100950 \text{ in. lbs.}$$

$$M_{EB} = EK_3\ (\theta_B - 3\phi_{EB}) = +0.004139\ E$$
$$= +103475 \text{ in. lbs.}$$

$$M_{BC} = EK_2\ (2\theta_B + \theta_C - 3\phi_{BC}) = -0.001302\ E$$
$$= -32550 \text{ in. lbs.}$$

$$M_{CB} = EK_2\ (2\theta_C + \theta_B - 3\phi_{CB}) = -0.002948\ E$$
$$= -73700 \text{ in. lbs.}$$

$$M_{CD} = EK_4\ (2\theta_C - 3\phi_{CD}) = +0.002948\ E$$
$$= +73700 \text{ in. lbs.}$$

$$M_{DC} = EK_4\ (\theta_C - 3\phi_{CD}) = +0.003646\ E$$
$$= +91150 \text{ in. lbs.}$$

The bending moment diagram and elastic curves may now be sketched, as shown in Figs. 7 and 8.

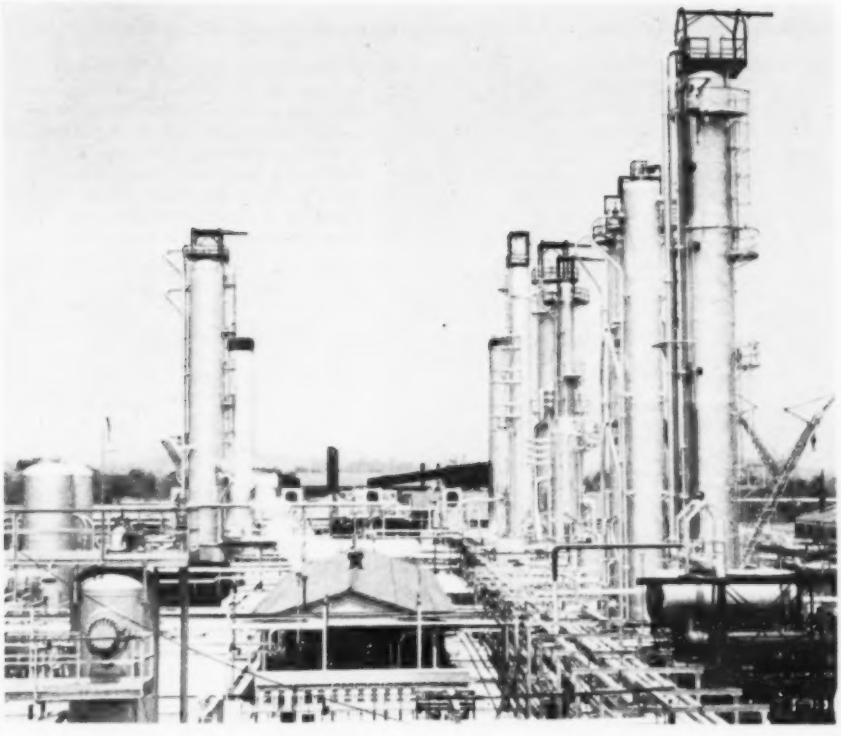
We may compute the reactions by isolation of each member just before the connections and solve for the reactions by the equations of statics as diagramed in Figs. 9 and 10.

The bending stress in the bend at C can be computed as indicated in Example I.

Bending Stresses in any straight section of the system are computed by the usual formula, $f_b = M/Z$.

References

(1) Hovgaard, William; *Journ. of Math. and Phys.*, vol. 7, no. 3 (Oct. 1928), vol. 7, no. 4 (Dec. 1928), vol. 8, no. 4 (Dec. 1929).
(2) "Expansion & Flexibility," Research Papers, Piping Engineering Series, No. 4.02; Tube Turns, Inc., Louisville, Ky.
(3) Fife & Wilbur; "Theory of Statically Indeterminate Structures," McGraw-Hill, New York (1937).



REFINING IN MEXICO starts with the combined natural gasoline plant and crude stabilization facilities at Poza Rica, in the heart of the largest oil producing area. From here treated crude goes to other plants for further processing. Crude stabilizer is at left of picture; on the right are depropanizer, rich oil still, de-ethanizing reabsorber, two absorbers, stablizer for natural gasoline and deisobutanizer

Refining in Mexico—Part 2

Crudes Are 'Tough' to Handle

High salt and sulfur contents pose equipment and operating problems in Poza Rica plant

By D. P. THORNTON, Jr.
Southwestern Editor

REFINERY technology in Mexico in general follows U. S. methods throughout. Well known and largely conventional processes are used. Most of the equipment there to date has been imported from the U. S. because the manufacture of similar items is just beginning in Mexico. Its steel industry centers about Monterrey, N. L. (rolling mills), and Mexico City (foundries). The principal product for the oil industry is pipe.

Most of the U. S. equipment suppliers furnishing refining equipment in Mexico have sales representatives but only a very few maintain technically trained staffs, or have warehouses and keep supplies of parts within the country. Only recently one pump manufacturer has installed a small factory, while another is understood to be arranging an assembly plant.

Chemical manufacturing also is just beginning in Mexico. Petrochemicals include elemental sulfur recovered from natural gas and ammonia synthesized from gas. The two are combined to form ammonium sulfate fertilizer. Plans are under way to produce alkylaryl-sulfonates on a small scale. The small tetraethyl lead plant near Mexico City has been shut down for several years; it depended on imported chemical intermediates. No other additives have been produced in Mexico.

Although at first these points appear rather distantly related, in practice they are not. Because the cost of equipment is much greater than in the U. S. when the long water or rail haul is considered, refineries must keep larger stocks of supplies in hand and anticipate requirements over a longer period of time than is customary in the U. S. The serious consequences of a breakdown obviously do not encourage extensive experimenting, mechanically or processwise.

Because of these equipment difficulties and since Pemex has not had the financial means to pay for the blind alleys so often encountered in research, use of well-known and proven processes have been an almost rigid rule in the Mexican refineries. Like many of the small U. S. refiners, Pemex has not believed it could afford the expensive pilot plant work which the installation of a relatively untried process usually means. In some instances it has called on the

Pemex Described

This series of articles is based on a 7-week tour of petroleum processing installations in Mexico, recently completed by the author. Article 1 appeared in the February issue, pp. 217-227, and described the organization of the government-owned single Mexican oil company, Petroleos Mexicanos, and told how refining operations there reflect both the economy and the geography of the country. Future articles will describe additional features of the industry.

technology of the U. S. oil industry, which is available at its door step. Consequently, the principal differences between U. S. and Mexican refineries will not be found in the methods employed—even the usual departures from basic processes are not common—but in the crudes processed and blending of the final products.

Most Mexican crude oils are predominantly paraffinic and asphaltic; so-called "mixed-base." The salt and sulfur content sometimes reaches prodigious amounts. The acid-gas in natural gas from the Poza Rica area, for instance—from whence comes the major volume of Mexico's oil—is measured in percent, not grains per 100 cu. ft. Only a part of it supports a 120 tons per day sulfur recovery plant.

As produced, the salt content of some crudes exceeds 500 lbs. per 1000 bbls. Several refineries process untreated crudes containing from 30 to 150 lbs. of salt per 1000 bbls. with obvious deleterious effects on crude distillation facilities. Several also use brackish water for cooling, of necessity.

Pemex personnel are good operators, perhaps sharpened by the fact that much of the equipment inherited in the plants acquired in 1938 is now very old and needed modernization when acquired. With modern equipment the newest refineries at Salamanca and Mexico City (Atzcapotzalco) achieve high on-stream efficiencies. The average for these two plants exceeds 90%; a large Dubbs cracker achieves a normal 100+ days on-stream and is turned around in 5 to 7 days. At Atzcapotzalco the butane isomerization and HF alkylation plants were on-stream 338 and 355 days, respectively, out of 365 last year.

The greatest contrast with U. S. practice is that the technically trained supervisory staffs are quite small, even at plants with the most complicated units. There are 90 technically-trained personnel out of 1200 on the refinery payroll at Atzcapotzalco, a total of 25 out of 600 in *operating* jobs at the 71,000 b/d Madero refinery at Tampico, 30 in the 30,000 b/d plant at Salamanca.

Some of the technical staffs received a part of their education in the U. S., while others received their operating training by visiting in U. S. plants or from technical personnel loaned by U. S. companies. Still others are Mexican educated and trained. All have highly responsible jobs. Women chemists and chemical engineers are found particularly at Salamanca and Atzcapotzalco.

Pemex now operates eight refineries, a large natural gasoline plant and sulfur recovery facilities. In addition, three plants are planned for the West Coast. Of the eight existing plants, two have been in operation only since 1950 and a third was practically rebuilt in 1947; the remaining plants are pre-1938 and only one has had two new units installed since that time.

These refineries are listed in Table 1, together with actual throughputs for 1951 and first half of 1952. Included in the table are the three projected refineries and anticipated rated crude throughputs from expansion and modernization now under construction, being designed or definitely considered. Latest average figure for Mexico's crude production is approximately 250,000 b/d. It will be apparent that within the next few years refinery capacity will have been increased about 68,000 b/d.

The all-new refineries are Reynosa and Salamanca. The refinery at Atzcapotzalco, expansion and modernization of which has been previously described,[1] is the "show-place" plant located in a suburb of Mexico City and is the only refinery producing aviation gasoline.

"Central Area" Plants

The key plant serving what may be termed geographically as the "central area" refineries, which represent the bulk of capacity, is located at Poza Rica, Veracruz, in the heart of the nation's largest oil producing area. Through pipelines it supplies all the stabilized crude processed at Salamanca, about half of the total run by the three Tampico refineries, and all the enriched crude run at Atzcapotzalco. In addition, there is a separate old 4000 b/d topping unit at Poza Rica which runs part-time to produce locally-needed products.

The cause for this unusual arrangement is principally the topography of Mexico and the inadequancy of transportation facilities into consuming areas. Poza Rica field crude is the one principally exported and, while there is a port at Tuxpan, 35 miles away, the principal export center for

Table 1—Refineries of Mexico—Present and Future

Refinery Location and Type	Design Crude Charge capacity BPSD	Thermal Cracking BPSD	Other Units b/d	Actual Thruput, BPCD 1951	Actual Thruput, BPCD 1952*	Planned Expansion BPSD Added Crude Thruput	Other Planned Process units or Facilities
Arbol Grande, Tamps. (S.A.W.L.)	23,000	.....	.....	13,500	16,000	.....	
Atzcapotzalco, D. F. (S.C.).....	52,000	14,500	(HFA) 813 BPSD, Isom 500 BPSD i-C_4 (C.D.)12,000	44,000	48,500	(S)28,000 by 1955	Edeleanu SO_2 extn. for kerosine treating in future. 15,000 b/d cat. cracking
C. Madero, Tamps. (S.C.A.W.)...	71,000	5,800	(C.D.) 12,000	46,000	51,500	.....	New boilers, elect. gen., 15,000 b/d cat. cracking. Modernize wax plant
Mata Redondo, Ver. (S.C.)	20,000	6,000	.....	7,300	7,700	.....	
Minatitlan, Ver. (S.L.).....	32,000	.....	.....	17,200	20,000	.....	7500 b/d cat. cracking
Poza Rica, Ver. (S. Su)†.....	4,000	.....	.....	3,000	3,500		
Poza Rica, Ver. (St. Cg, Su).....	(St)100,000† (Cg)116,000‡ Mcfd	.....	..... (Su) 120 t/d‡	.....	.....	(Su)120 t/d‡ (Cg)100,000 Mcfd.‡	Plant depropanizes Poza Rica Crude for processing elsewhere. Processes natural gas, recovering 120 t/d of sulfur and 4000 b/d liquid hydrocarbons
Reynosa, Tamps. (S)	4,000	.....	.....	2,200	3,000	.....	
Salamanca, Gto. (S.C.)	30,000	4,500	(CD)12,000	20,000	24,000	(S)10,000	2500 b/d finished solvent lubes & wax.
Mazatlan, Sina. (S)	.....	.....	.....	.....	.....	10,000**	
Guaymas, Son. (S)	.....	.....	.....	.....	.....	10,000**	
Salina Cruz, Oax. (S)	.....	.....	.....	.....	.....	10,000**	
Total	236,000	30,800	.....	153,200	174,200	68,000	

* On basis first six months 1952 only.
** Ultimate capacity 15,000 B.P.S.D.
† Exclusive of crude stabilization and natural gasoline recovery.
‡ Not considered in totals; crude and gasoline included in thruputs for Atzcapotzalco, Salamanca and C. Madero.
S—Skimming
C—Thermal Cracking
W—Wax
A—Asphalt
L—Conventional Lubes
Su—Sulfur, Tons/sd
st—Stabilization of Crude
Cg—Natural gasoline and LPG
HFA—HF Alkylation
CD—Catalytic Desulfurization
Isom—Butane isomerization

crude and products is Tampico, 130 miles north.

The terrain between Poza Rica (in hilly country) and Mexico City literally traverses the backbone of Mexico. The pipeline takes crude from an elevation of 170 ft. above sea level to 8300 ft. enroute to Mexico City, posing some difficult design as well as construction and maintenance problems. Indeed, in a distance of 34 miles the line climbs 7600 ft. and some of this, as the writer can personally attest, is almost straight up. A similar situation exists in piping crude to Salamanca, where the maximum elevation reached is approximately 7500 ft. above Poza Rica. To Tampico the line descends from 170 ft to sea level across many hills, swampy sections and rivers.

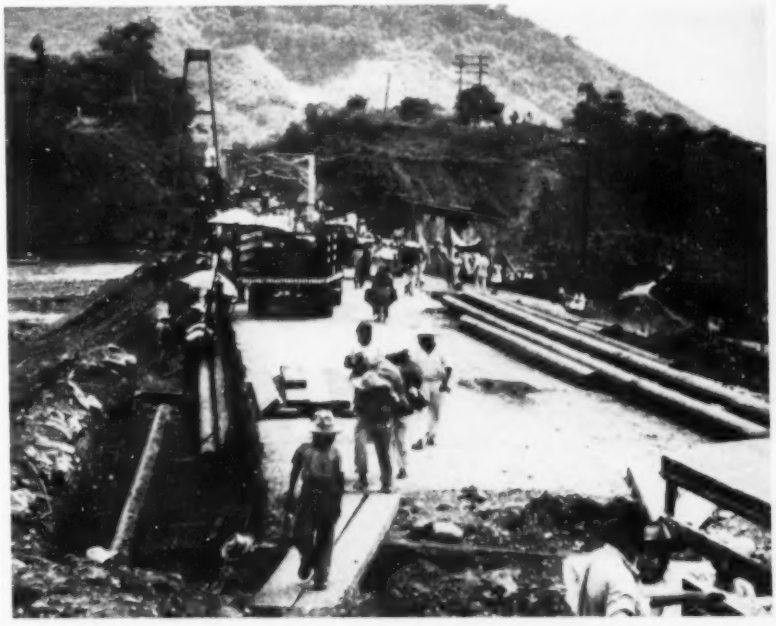
Consequently, to minimize evaporation losses and segregate light ends for Atzcapotzalco operations, most of the Poza Rica crude is stabilized to a low vapor pressure. The light ends are injected into the virgin crude to Atzcapotzalco and Salamanca, along with most of the natural gasoline. When gasoline is injected into the stabilized crude going to Tampico, isobutane is split out for injection into the Atzcapotzalco stream.

The only modern natural gasoline plant in Mexico is located at Poza Rica. It is designed to process approximately 120,000 Mcfd. of 325 psi oil well gas containing approximately 4 vol.-% H_2S and 17% CO_2 as taken from the crude in field separators. About 48,000 Mcfd. are received at 60 psi. and 88,800 Mcfd. at 280 psi.

The low pressure gas is boosted in two stages to 325 psi. in a battery of 22 Clark compressors of 300 Hp. each. In the second stage of compression, uncondensable gas from the crude stabilization plant enters at the interstage cooler so that any liquefiable hydrocarbons it contains may be recovered. High pressure gas is similarily stepped up to 325 psi. in two 800 Hp. Clarks.

The combined gas stream is charged to the sweetening plant, which is entirely separate from all other Poza Rica facilities and includes a sulfur recovery plant. A description of the sulfur plant will be found in the article "Sulfur via the Belt Line" on page 389 of the Petrochemical Section in this issue.

Considerably more gas than the design figure of 120,000 Mcfd. is now available in Poza Rica, due to further field development since the last addition to this plant in 1946. Furthermore, a market for the butane, as well as for considerable propane, can be readily developed. Consequently, both gas processing and sweetening facilities are shortly to be doubled and the appropriate pressure storage installed (there is very little now), at a cost for equipment alone estimated at $15 million.



REPAIRING A BREAK in the crude line from Poza Rica calls for much manual labor because the terrain makes it difficult to move in heavy equipment

Returned sweetened gas is compressed to 600 psi. in seven 800-Hp. compressors and enters two paralleled 600 psi. absorbers in counterflow against 322.5 gpm. of 170 molecular weight oil (44.3°API). Four water-cooled inter-tray coolers are employed for temperature control and now consideration is being given to refrigerating both inlet gas and oil for greater absorption on light ends. Currently about 70% of the isobutane present in the wet gas is being recovered in the absorbers and approximately 32% of the propane.

The oil is flashed to 140 psi. in the de-ethanizing reabsorber, then stripped in a conventional still. The 140 psi. flash gas is used as plant fuel and also is recompressed in stages to 600 psi. to join the residue gas from the absorbers.

About 30,000 Mcfd. of this stream is further compressed in a battery of five 800-hp compressors to 2450 psi. for use in field repressuring operations. Of the balance, 16,000 Mcfd. enters the 20-in. pipe line to Mexico City, to be used as refinery fuel. This will shortly be doubled by installing line compressors (none are now used) and any excess sold for industrial purposes. (No gas will be supplied for domestic purposes in the Capital.)

Conventional natural gasoline processing is used in the remainder of the plant, the still overhead vapors being condensed and overhead vapors for the accumulator being compressed. To aid in liquefying these vapors following compression, the liquid condensate recovered from crude stabilizing operations is injected at this point, ahead of the aftercooler, following which the combined streams enter the depropanizer charge accumulator, or raw make tank. Principally due to the lack of facilities for storage and distribution, most of the propane produced is flared or used with natural gas in the sulfur plant as an aid in oxidizing H_2S for sulfur recovery. A small quantity is mixed with butane as LPG.

The gasoline bottoms from the depropanizer may or may not be further processed, depending on local requirements. When necessary to produce normal butane to fulfill commitments for LPG, the gasoline is debutanized, the overhead product being run to storage. This same tower alternately is used as a deisobutanizer, the isobutane being incorporated with natural gasoline injected into the Atzcapotzalco crude line and the butane sent to the bottling plant, and also injected into Salamanca or Tampico crude lines.

When there is no need for butane locally and no natural gasoline is being shipped with the crude either to Tampico or Salamanca, this tower is not operated. This arrangement assures a continuing supply of low-cost isobutane for the alkylation unit at Atzcapotzalco, where a butane isomerization unit is operated only enough to supplement this supply.

Crude Stabilization

Crude production at Poza Rica amounts to approximately 140,000 b/d,

of which 25,000 b/d may be considered very salty—more than 30 or 40 lbs. per 1000 bbls.—and the balance "low salt". The high- and low-salt crudes are brought to the plant separately, and only the high-salt crude is treated.

The desalting operation is quite simple and uses a Tretolite compound as an emulsion-breaker. It consists of heating salty oil by exchange with stabilized crude to 201° F. and mixing with 10% by volume of hot water, emulsifying through a mixing baffle. The resulting emulsion is allowed to settle in two paralleled primary settling tanks, whence it flows to a final tank where the emulsion breaker is added to complete the separation. The crude, now containing about 5 lbs. of salt per 1000 bbls., then joins the low-salt crude stream.

The topping facilities are designed to handle 100,000 b/d of crude, essentially depropanizing it. The combined streams are preheated with stabilized crude to 230° F. and charged into the upper third of the stabilizer. This column is reboiled by splitting the total bottoms stream to two fired McKee heaters, from which it returns at 350° F.

The stabilizer overhead, as previously noted under gas processing, is condensed and any vapors compressed to 600 psi. for injection into the oil well gas stream. The liquid commingles with the raw make from natural gasoline recovery.

The crudes as received at the various refineries served by Poza Rica will vary according to stabilizing operations and the amounts of natural gasoline which may be injected into the respective streams; the latter is a function of refinery operations. However, an average can be struck and is presented in Table 2.

From this will be noted the effect of enrichment on the Atzcapotzalco stream and to a lesser extent on the Salamanca stream when, for some reason, all the light ends cannot be included in crude to Mexico City. Tampico, on the other hand, seldom receives light ends as shown by the lower API gravity of this stream. Refineries there, however, also charge other crudes in addition to that from Poza Rica.

Four crude pipelines commence at Poza Rica, moving crude to Mexico City (Atzcapotzalco), Salamanca, Tampico and the port of Tuxpan. Tuxpan also is connected by pipe line with Tampico and there is a connection between the Poza Rica-Tampico line and the Poza Rica-Tuxpan line. Tuxpan, the nearest port, originates some boat and barge shipments of crude, largely for domestic destinations.

There are nine stations on the 50,000 b/d Poza Rica-Atzcapotzalco line (plus the pumps at Poza Rica), each consisting of two electrically-driven centrifugal pumps generally operated in series to achieve desired line pressure of 850-900 psi. A third pump is held in reserve. Additional pumps will be installed to increase line capacity to 80,000 b/d in the near future. At present the remaining 10 in. sections of this line, some of which show evidence of serious corrosion, are being replaced to make it a full 12-in. line over its 150-mile length.

These stations range in spacing from three to 34 miles apart, depending on the elevation of the intervening terrain, and receive power from two nearby hydroelectric plants.

Similarly, seven of these stations also house the electrified reciprocating pumps (formerly on the Atzcapotzalco line) moving 30,000 b/d of crude through the 14-in. Poza Rica-Salamanca line, 280 miles long. This line now operates at a pressure of 800 psi., the crude moving by gravity from station No. 7 the remaining 250 miles to Salamanca. When the capacity of this refinery is increased within two years to 40,000 b/d another station will be added at Pachuca, 43 miles further on, with future possibility that another will be needed at San Juan del Rio, 90 miles from Pachuca, to bring the line to design maximum of 60,000 b/d.

There are no stations between Poza Rica and Tampico or Tuxpan. Tampico now receives approximately 42,000 b/d with 20,000 to 25,000 b/d additional being exported.

As an interesting aside, crude pipe line breaks generally develop during the period June to October—the rainy season. For obvious reasons, the Salamanca and Atzcapotzalco lines follow the highway through the mountains and, because of torrential rains often experienced during this season, landslides are common. Late in July of 1952 these lines were out for approximately 24 hours following three major landslides, several minor breaks and a ruined bridge which carries lines and highway across the Rio Cazones.

It was repaired by working 'round the clock to quickly restore crude to Atzcapotzalco with temporary Dresser couplings until permanent repairs could be made after the highway was restored. Atzcapotzalco, incidentally, suffered an emergency shutdown since, with the limited present capacity of the line, the plant operates almost directly off the line.

The repairs were no small accomplishment as the writer observed during an inadvertent land trip through the area. It was necessary to use largely hand labor in heavy rains because damaged roads made access by motorized equipment extremely hazardous. Meanwhile, the refinery operators seized the chance to make alterations to a small crude unit.

Poza Rica Refinery

As indicated previously, the Poza Rica topping plant is one of the smallest refineries in Mexico and serves only the immediate vicinity of Poza Rica. Since this area is not "Tourist Territory" as yet and not readily reached by automobile except from Mexico City, gasoline consumption is not high and 80 oct. Super Mexolina is not available.

The refinery, not to be confused with crude stabilizing operations some distance away, consists of an old fired heater charging 3000 b/d of crude. It produces for the local market approximately 1000 b/d of 70 oct. Mexolina (regular gasoline), 60 b/d of stove oil, 40 b/d of tractor fuel, 50 b/d of Diesel fuel, 250 b/d of absorption oil for the natural gasoline plant and 400 b/d of No. 6 fuel oil. In addition, 500 b/d of light ends, 100 b/d of unfinished kerosine and 1600 b/d of residual fuel are returned to the pipe line pump station for injection into the Tampico crude line. Occasionally asphalt and road oils are produced for local use.

Because of the restricted area served, largely agricultural, and because of its hilly nature not well-suited for power-driven cultivation, the Poza Rica topping plant does not operate steadily. Indeed, at present it is operating not more than ten days to two weeks monthly.

(Continued next month)

Table 2—Analysis of Poza Rica Crude

	Field	By Pipe Line To		
		Atzcapotzalco	Salamanca	Tampico
Gravity, ° API	28 to 32	33 to 35	31	28.0
Viscosity, SSU @ 100	....	....	....	82
Water & Sediment, %	1.0	0.2	0.2	0.2
Sulfur, %	1.8	1.6	1.8	1.98
Conradson Carbon, %	....	....	....	4.86
Ash, %	....	0.03	0.03	0.03
Salt, lbs/1000 bbls.	25 to 100	25 to 60	25 to 60	25 to 60
% Paraffin of 129 M.P.	3.2	....	....	0.95
Distillation, Vol.—%				
Gasoline, 395° EP	19.75	27.03	20.0	20.0
Kerosine	11.45	14.37	12.0	13.0
Gas Oil	19.3	11.37	12.0	7.0
Wax Distillate	....	....	....	20.4
Residue	47.5	47.07	54.0	38.6
Loss	2.0	0.16	2.0	1.0

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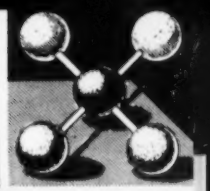
(1) Mena, R. O.; Guerrieri, S. A.; and Wilson, D. W.; "Product Flexibility, Low Fuel Consumption Feature Modernized Pemex Refinery," PETROLEUM PROCESSING, p. 334-348, May 1947.



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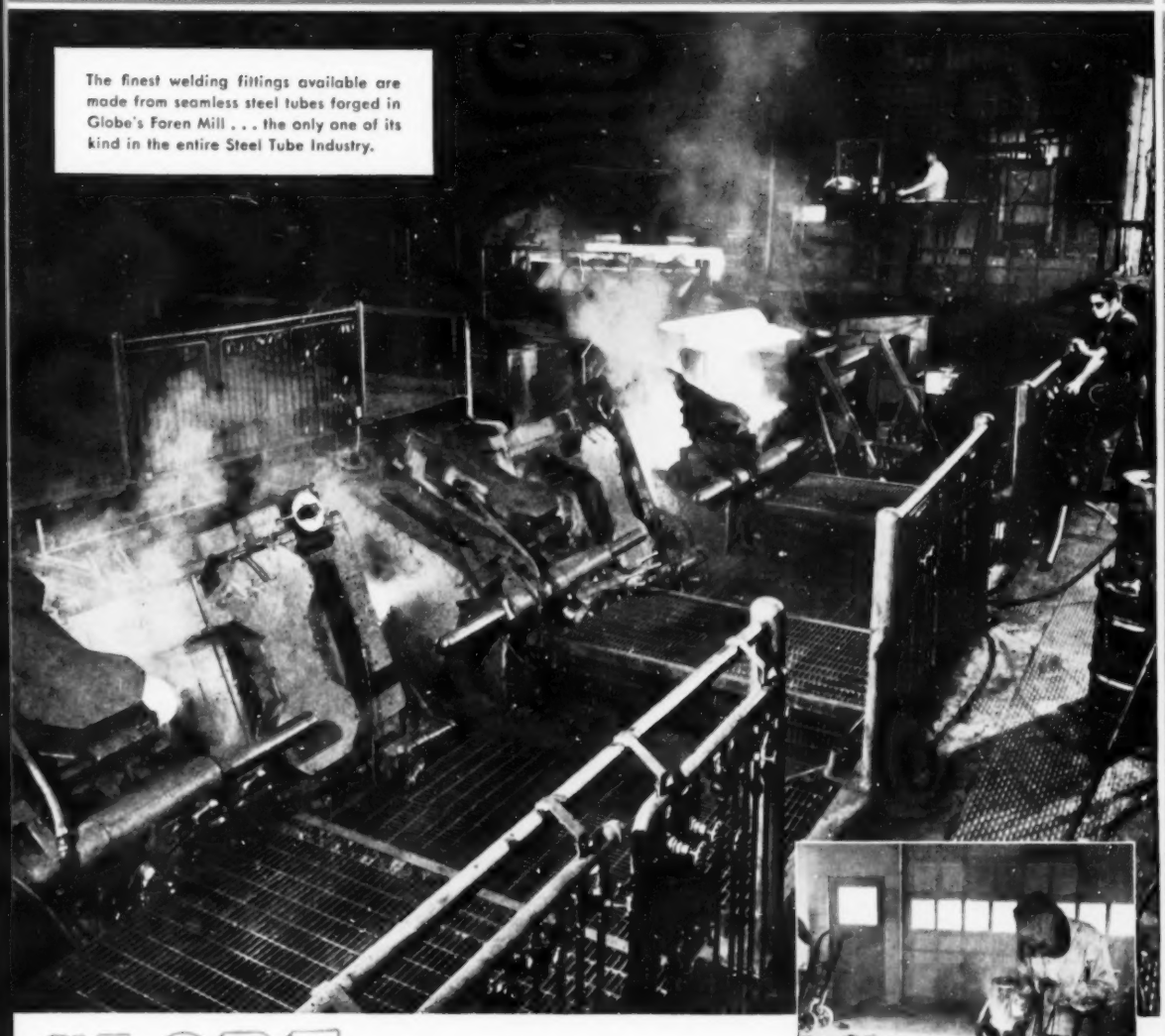

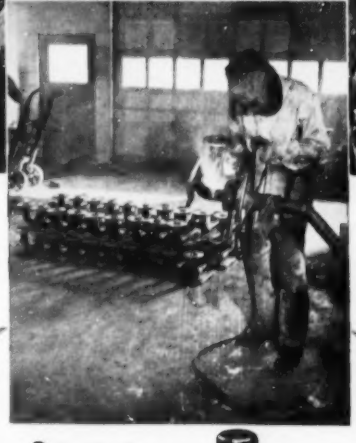

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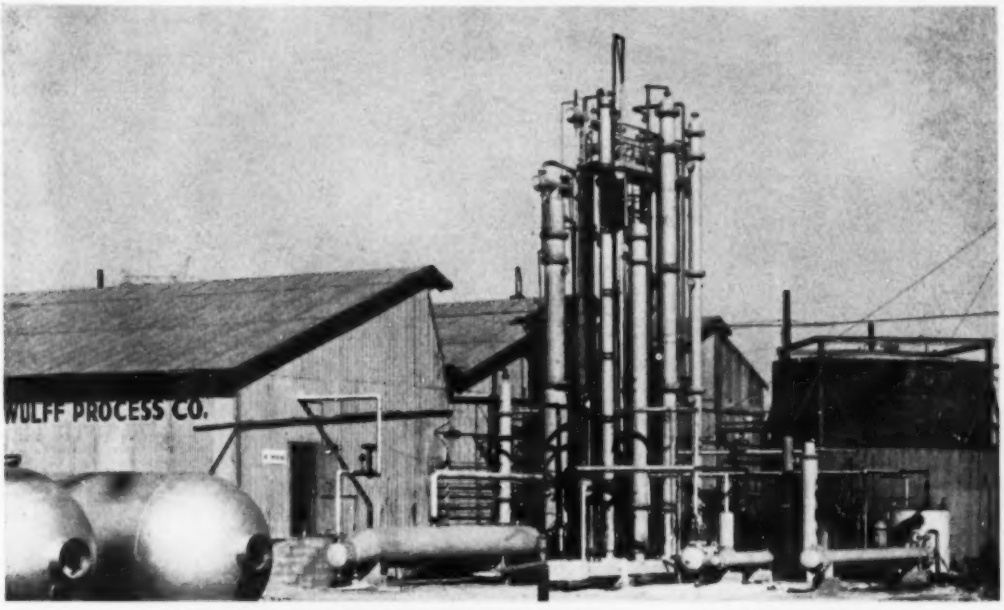


FOR TWO YEARS this pilot plant at Maywood (Los Angeles), Calif. has been producing acetylene from propane on a commercial basis

THE WULFF PROCESS FOR

Acetylene from Hydrocarbons

By ***MARCEL J. P. BOGART*** *and*
GERALD R. SCHILLER
The Lummus Co., New York,
and
CLARENCE J. COBERLY,
Wulff Process Co., Los Angeles

THE Petrochemical industry is today turning its attention to acetylene as a major raw material and building block for the manufacture of chemicals and synthetic products. Contributing to this intensified interest is the availability of new and improved processes for the large-scale production of acetylene from hydrocarbon charging stocks. These hydrocarbon conversion processes have challenged successfully the traditional carbide route, long the dominant method for the production of acetylene.

Of prime importance among these is the Wulff Process, development of which has now reached the stage where a reliable economic evaluation of its potentialities can be made.

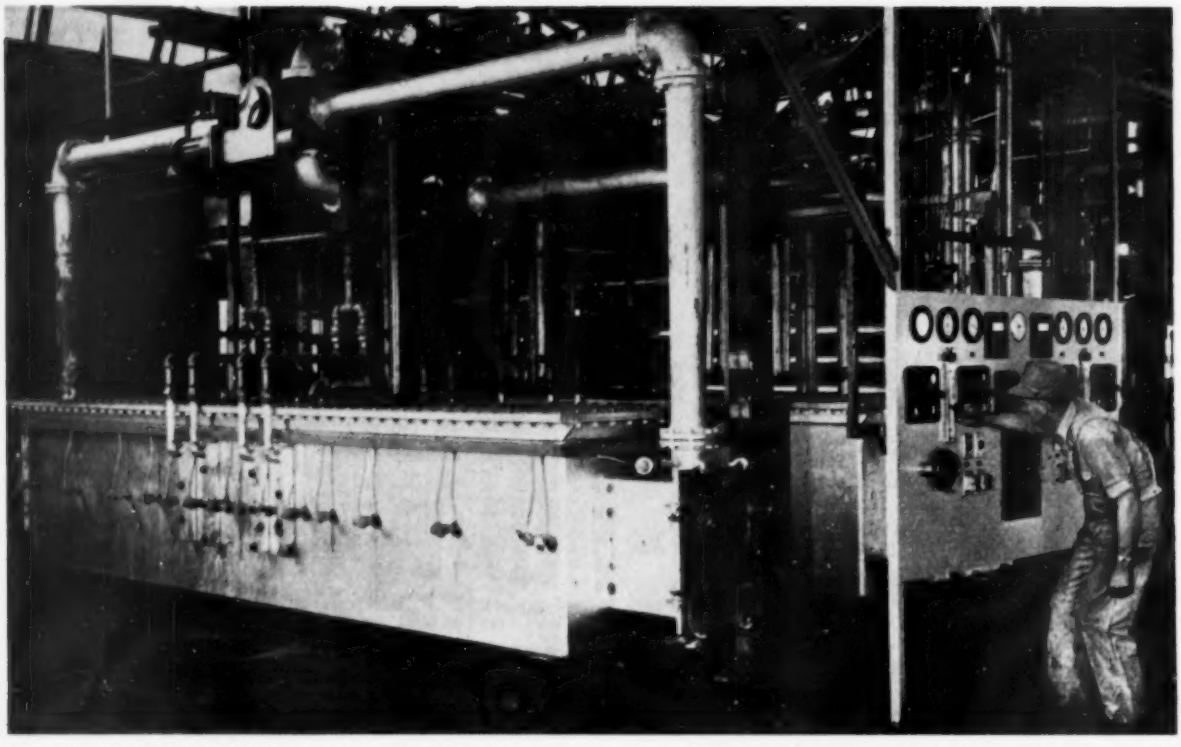
These new processes have in common the use of hydrocarbon feed stocks in high temperature pyrolytic operations. The high temperatures required for the hydrocarbon conversion step are achieved by various special methods and apparatus, such as partial combustion of the charge material, modified electric arc, or a regenerative technique in suitable refractory equipment, the latter exemplified by the Wulff Process.

These processes all yield a cracked gas containing acetylene diluted with various other reaction products. Chemical-synthesis grade acetylene may be separated and purified from this cracked gas by any of several well-known methods.

Major commercial installations in this country have to date followed foreign practice, adopting variations of the partial combustion process. In this scheme, regulated quantities of oxygen are admitted to the pyrolysis apparatus and burn a portion of the hydrocarbons charged to raise the resultant gas mixture to reaction temperature. Substitution of air for oxygen has not proven economical because of further dilution of the mixture of cracked and combustion gases by the nitrogen from the air. The major disadvantage of this process lies in the necessity for oxygen-producing facilities and in the added complication of separating acetylene from cracked gases further diluted with products of combustion.

The Wulff Process does not require an oxygen plant for its operation, as does the partial combustion process, nor does it require a large supply of electric power, as for carbide or arc-generated acetylene. In addition, cracked gas from the Wulff Process is undiluted with products of combustion.

The high degree of thermal economy of the Wulff Process is achieved by employing regen-



HEART OF THE PROCESS is the regenerative furnace shown above, one of a pair put into operation at the Maywood plant last September. Checking instrument panel is Boyd Stewart, plant superintendent

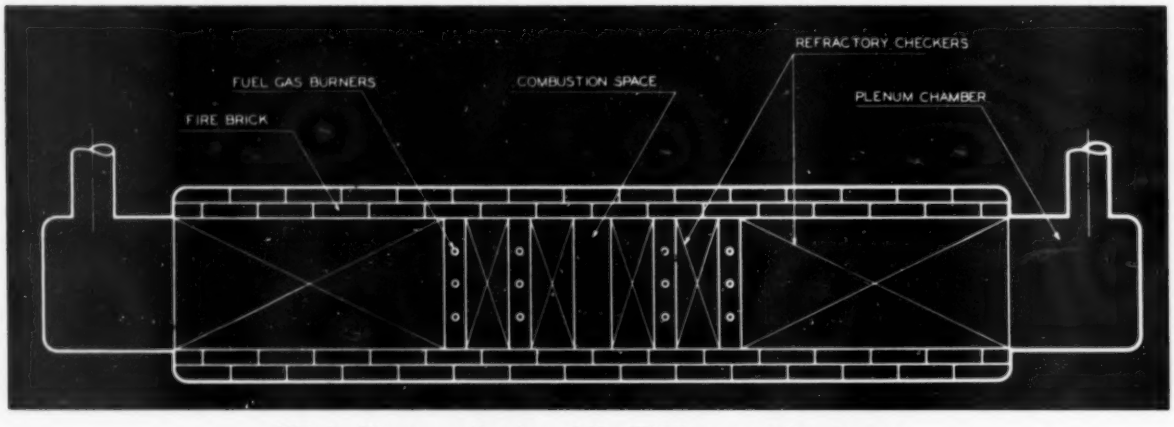


FIG. 1—Diagrammatic view of the Wulff regenerative furnace

erative furnaces which operate alternately on heating and cracking operations. The resultant combustion and cracked gases are removed separately. The heat stored in the refractory during the heating step is removed by pyrolysis of the feed gas and is restored by the combustion of fuel and preheated air.

History of the Wulff Process

The Wulff Process has been in operation for over two years in the Los Angeles plant of the Wulff Process Co., which produces bottled acetylene for welding purposes. The plant initially consisted of one furnace with its auxiliary apparatus, a unit for recovery of the dilute acetylene in the cracked gas, and facilities for filling the cylinders with the recovered product acetylene.

This furnace was operated at full capacity on a five-day-per-week basis producing acetylene from either propane, natural gas, or ethane. After 14 months service it was opened for inspection and evaluation of its refractory materials. During this operating period no significant loss in yield or increase in pressure drop at full throughput was encountered. Table 1 compares the performance of this furnace on cracking propane at three different times during this first operating period, and confirms the continuity of throughput and yield.

Inspection of the furnace after this period showed that maintenance would be a small factor and, indeed, that these costs would not be a significant item in the manufactured cost of the acetylene product.

The success of these operations led the Wulff Process Co. to initiate an expansion program in 1952. With assistance from the Lummus Co., twin furnaces of twice the capacity of the

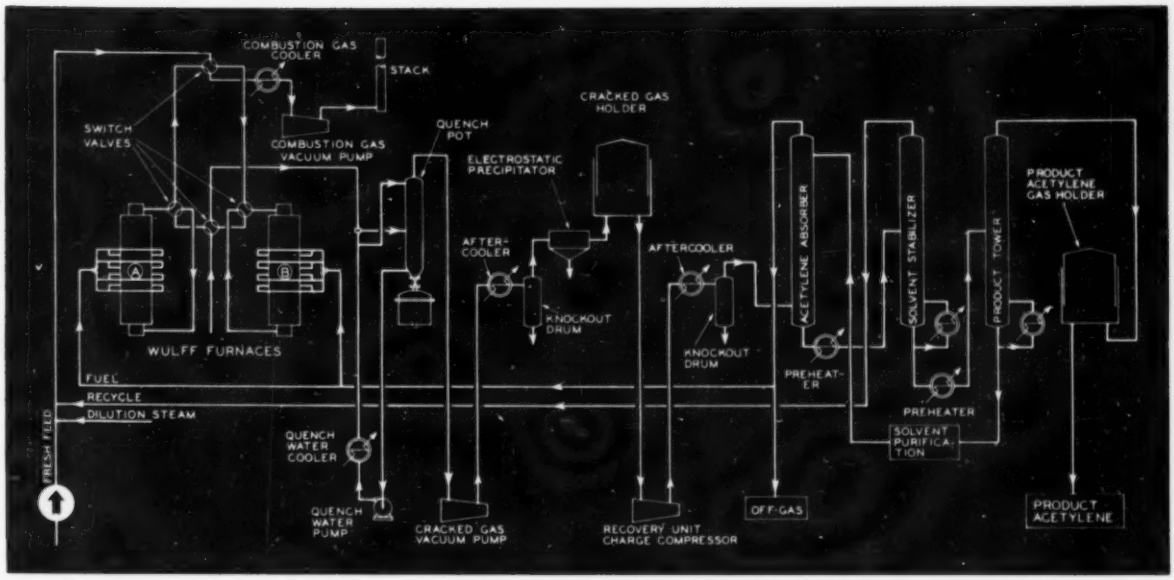


FIG. 2—Flow diagram of Wulff acetylene process

original furnace were installed, together with their auxiliary apparatus. Necessary changes were made to the recovery unit to accommodate the four-fold increase in production rate.

The expanded plant is being operated currently both to produce cylinder acetylene welding gas and to supply the data necessary for design of large-scale Wulff plants.

Pyrolysis Section

The Wulff regenerative furnace is the heart of the pyrolysis section. Its design is shown schematically in Fig. 1. It consists essentially of a steel box with a bolted cover, lined with insulating and fire brick. Except for a central combustion space and fuel gas injection slots, it is filled with high-temperature refractory "checkers" of special design.

Fuel gas burners are located on each side of the combustion section, these being used alternately depending upon the direction of flow of heating gas within the furnace. Plenum chambers fitted with gas distribution devices are provided at the ends of the furnace to facilitate the introduction and removal of the various gas streams.

Continuous output of cracked gas is achieved by installing Wulff furnaces in pairs. The Wulff furnace operates on a four-part cycle, the complete sequence consisting of a pyrolysis step and a heating step in one direction, followed by a pyrolysis step and a heating step in the reverse direction of the gas flow. Each step is of approximately one minute duration, making the total cycle time in the order of four minutes. Control of these operations is obtained by a cycle-timer operating interlocked four-way plug type switch valves.

The schematic flow diagram, Fig. 2, shows the flows when Furnace A is on the heating step of the cycle and Furnace B is on the cracking step. Air is shown being drawn into Furnace A for combustion in its center section with the fuel gas admitted to the upstream burners. The products of combustion leaving the furnace are cooled, sent to the combustion gas vacuum pump, and discharged to a stack.

For the cracking operation in Furnace B, the hydrocarbon charging stock diluted with steam is admitted to the furnace countercurrent to the preceding flow of heating gases. The cracked gas from the furnace passes to a quench system for condensation of most of the dilution steam and the small amount of liquid products and tars formed during pyrolysis. The remaining gas is compressed to atmospheric pressure in the cracked gas vacuum pump, cooled, and flows through a knock-out drum and an electrostatic precipitator to the cracked gas holder.

Short pyrolysis residence time favors high yields of acetylene, which undergoes rapid decomposition in the temperature range required for its formation. By operating the Wulff furnace under vacuum and in the presence of dilution steam, gas residence time in the reaction section of a Wulff furnace is in the order of 0.03 sec.

The Wulff Process may be operated using any conveniently vaporizable hydrocarbon or hydrocarbon mixture as charge stock. This flexibility is accomplished by control of the temperature pattern within the furnace, as shown in Fig. 3. This drawing shows various temperature profiles measured along the gas path in the reaction section of a Wulff furnace at a constant production level, but with different combustion patterns. These temperatures were measured with porcelain-sheathed thermocouples inserted through the furnace lining and contacting the edge of the crackers. A traverse made across the center of the furnace with a bare thermocouple in the gas stream during the cracking step gave a difference of only 50° C. between minimum and maximum readings, attesting to

Table 1—Wulff Cracking Furnace, Continuity of Performance on Once-Through Operations

Date	Dec. 28, 1951	April 8, 1952	Nov. 17, 1952
Run No.	138	145	150
Furnace Feed, lb/hr.:			
Propane	231	231	237
Steam	467	463	467
Total	698	694	704
Acetylene in Cracked Gas:			
Concentration, Mol. %*	12.54	13.90	13.26
Quantity, lb/hr.	64	74	72
Yield, lb/100 lb. Propane	27.8	32.1	30.2
Furnace Operating Pressure, psia.	10.1	7.7	7.6
Furnace Pressure Drop, in. Hg			
Cracking	2.2	2.0	1.8
Heating	1.3	1.2	1.1

* Water- and tar-free basis

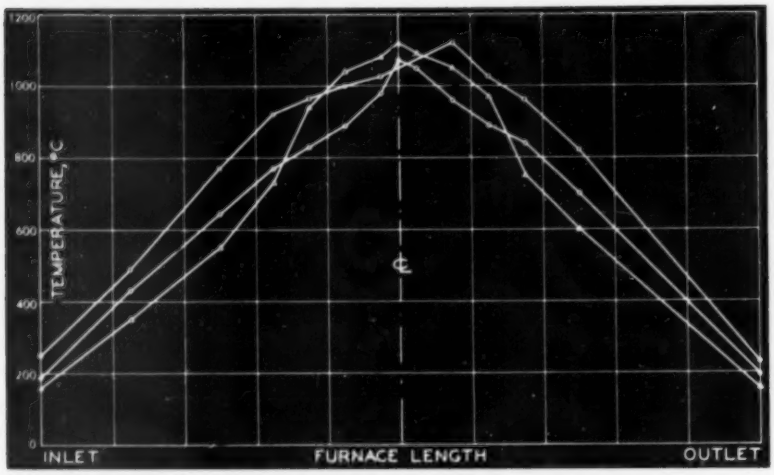


FIG. 3—Wulff furnace temperature pattern

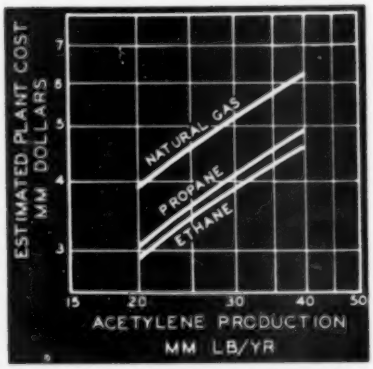


FIG. 4 — Estimated acetylene plant cost vs. acetylene production, for various feedstocks

Table 2—Material Balances, Producing Acetylene from Various Raw Materials

20,000,000 LB./YEAR OF ACETYLENE FROM NATURAL GAS

Stream	Fresh Feed		Heater Effluent		Net Off-Gas		Product Acetylene	
	mols/hr.	lb./hr.	mols/hr.	lb./hr.	mols/hr.	lb./hr.	mols/hr.	lb./hr.
Hydrogen	....	....	1,052.9	2,106	688.2	1,376	...	....
Nitrogen	....	....	38.5	1,078	25.9	702	...	....
Oxygen	....	....	4.4	141	2.9	92	...	....
Carbon Monoxide	....	....	176.5	4,942	115.2	3,228	0.1	2
Carbon Dioxide	4.2	185	35.4	1,558	22.4	986	0.5	21
Methane	541.6	8,665	326.5	5,224	213.2	3,410	0.2	3
Acetylene	....	....	106.5	2,769	3.4	89	97.1	2,525
Ethylene	....	....	5.3	148	3.9	109	0.2	5
Ethane	22.7	682	1.3	39	0.8	26	...	....
Methyl Acetylene	....	....	6.5	260	4.6	182	0.3	12
Propylene	....	....	0.8	34	0.6	23	...	....
Propane	4.8	211	1.8	79	1.2	52	...	....
Diacetylene	....	....	.8	40	0.6	26	...	....
Vinyl Acetylene	....	....	1.3	68	0.8	43	...	2
Ethyl Acetylene	....	....	0.5	27	0.3	19	...	....
Butanes	1.4	81	.....	....	.....	....	...	....
Pentane +	0.6	43	.....	....	.....	....	...	....
TOTAL	575.3	9,867	1,759.0	18,513	1,083.1	10,363	98.4	2,570
Molecular Weight	17.16		10.52		9.57		26.11	
MSCFD (60° F., 1 atm.)	5,234		16,000		9,852		896	
Overall Acetylene Yield	25.6 lb. acetylene/100 lb. fresh feed.							
Off-gas fuel value	412 Btu./cu. ft.							

20,000,000 LB./YEAR OF ACETYLENE FROM ETHANE

Stream	Fresh Feed		Heater Effluent		Net Off-Gas		Product Acetylene	
	mols/hr.	lb./hr.	mols/hr.	lb./hr.	mols/hr.	lb./hr.	mols/hr.	lb./hr.
Hydrogen	....	....	495.4	991	366.7	733	...	....
Nitrogen	....	....	16.7	467	12.4	347	...	....
Oxygen	....	....	1.5	48	1.1	35	...	....
Carbon Monoxide	....	....	64.0	1,792	47.3	1,326	...	....
Carbon Dioxide	....	....	15.2	669	10.9	480	0.4	18
Methane	5.2	83	45.7	731	33.8	541	...	....
Acetylene	....	....	99.1	2,577	1.5	39	97.1	2,525
Ethylene	....	....	15.2	426	11.2	314	...	....
Ethane	163.9	4,917	1.5	45	1.1	33	...	....
Propane	3.5	154	.....	....	.....	....	...	....
Heavier	....	....	7.6	363	5.0	239	0.8	39
TOTAL	172.6	5,154	761.9	8,109	491.0	4,087	98.3	2,582
Molecular Weight	29.86		10.64		8.32		26.26	
MSCFD (60° F, 1 atm.)	1,570		6,930		4,466		895	
Overall Acetylene Yield	49.0 lb acetylene/100 lb. fresh feed.							
Off-gas fuel value	341 Btu./cu. ft.							

20,000,000 LBS./YEAR OF ACETYLENE FROM PROPANE

Stream	Fresh Feed		Heater Effluent		Net Off-Gas		Product Acetylene	
	mols/hr.	lb./hr.	mols/hr.	lb./hr.	mols/hr.	lb./hr.	mols/hr.	lb./hr.
Hydrogen	....	....	500.9	1,002	346.6	693	...	....
Nitrogen	....	....	49.0	1,372	33.9	949	...	....
Oxygen	....	....	3.6	115	2.5	80	...	....
Carbon Monoxide	....	....	63.5	1,778	43.9	1,229	...	....
Carbon Dioxide	....	....	10.9	480	7.3	321	0.4	18
Methane	....	....	140.7	2,251	97.4	1,558	...	....
Acetylene	....	....	99.1	2,577	1.4	36	97.1	2,525
Ethylene	....	....	29.0	812	20.1	563	...	....
Ethane	2.9	87	.....	....	.....	....	...	....
Methyl Acetylene	....	....	1.9	76	1.1	44	0.3	12
Propane	136.1	5,988	1.8	79	1.2	53	...	....
Butane	4.3	249	.....	....	.....	....	...	....
Higher Acetylenes	....	....	7.0	350	4.4	220	0.6	30
TOTAL	143.3	6,324	907.4	10,892	559.8	5,746	98.4	2,585
Molecular Weight	44.13		12.00		10.26		26.27	
MSCFD (60° F, 1 atm.)	1,303		8,254		5,092		895	
Overall Acetylene Yield	39.9 lb. acetylene/100 lb. fresh feed.							
Off-gas fuel value	411 Btu./cu. ft.							

the uniformity of conditions within the furnace.

In most applications it will be found advantageous to return unconverted hydrocarbons and by-product materials to the pyrolysis step to increase the ultimate yield. The recovery unit is accordingly designed to supply a recycle stream which is fed to the furnaces together with the fresh feed and the dilution steam. Abbreviated material balances, on a water-free basis, and for recycle operation, are given in Table 2 for natural gas, ethane and propane cracking, at a production rate of 20,000,000 pounds of acetylene per year.

Recovery Unit

It can be seen from the cracked gas compositions given in Table 2 that no new or unusual problems are met in the design of a recovery unit for separating high-purity acetylene from Wulff cracked gas. Any one of several well-known methods, or a combination of these methods, for the separation of lower molecular weight hydrocarbon gases may be used. Low temperature fractionation and absorption with selective solvents have been employed commercially. Various solvents have been used in the recovery unit of the Wulff demonstration plant. It is a selective absorption gas plant, and is operating currently with dimethyl formamide as the solvent.

The process sequence in use now is the removal first of the extremely reactive diacetylene from the cracked gas, followed by absorption of the acetylene and more soluble components. A final separation is made between the acetylene and any contaminants absorbed in the rich solvent. The experience obtained with dimethyl formamide has shown it to have excellent capacity and selectivity for the recovery of Wulff cracked gas.

Because the design of the recovery unit for commercial scale Wulff plants is dictated by the end use of the product acetylene, a specific design is not considered here. The recovery system shown in Fig. 2 is only schematic.

Table 3-A—Basis for Economic Study

CAPITAL CHARGES

Amortization Period	5 years and 10 years
Interest on Investment	3.85%
Property Taxes	$1.05/M of investment
Property Insurance	$38,000/yr. for 20 MM lb./yr. plant 53,700/yr. for 40 MM lb./yr. plant

OPERATING CHARGES

Raw materials, Utilities, and Chemicals:	
Feedstock:	
Natural Gas	$0.10-0.35/MM Btu
Ethane	0.010-.015/lb.
Propane	0.035-.045/gal.
Power	0.0062/KW.
Steam, High Pressure	0.40/M lbs.
Cooling Water:	
Exchangers	0.015/M gal.
Quench Make-up	0.10/M gal.
Off-Gas Credit	natural gas prices, where applicable. 0.15/MM Btu. elsewhere
Oil and Tar Credit	0.012/lb.
Solvent	0.48/lb.
Royalty	0.00125/lb.
Maintenance Supplies	2% of investment
Labor and Administration	see details in Table 3-B.

Table 3-B—Labor and Administration

			$/Yr.
Day Personnel:			
Plant Superintendent			$13,000
Chief Chemist			8,500
Plant Engineer			7,500
Secretary		$1.76/hr.	3,660
Clerk		1.45	3,016
Janitor		1.45	3,016
		Total	$38,692
Shift Personnel:*			
Shift Foreman	4 at	$2.75/hr.	$22,880
Stillman	4 at	2.50	20,800
Compressor Operator	4 at	1.125	17,680
Fireman	4 at	1.75	14,560
Controlman	8 at	1.90	15,808
Chemist	4 at	2.00	16,640
Instrument Man	4 at	2.25	18,720
Mechanic	4 at	2.50	20,800
Helper	4 at	2.00	16,640
Watchman	4 at	1.30	10,816
		Total	$175,344
Total Payroll			$214,036

* includes shift-breakers

It may be possible to eliminate the recovery unit entirely by feeding the cracked gas directly to the acetylene consumer. Other consumers require a 99.5% or better purity acetylene.

The recovery unit may also be required to perform other functions in addition to that of separating and concentrating the acetylene product. For example, it may be required to operate as a feed preparation step. Again, it may be operated to produce two or more products. For these special requirements, additions or modifications must be made to the recovery unit.

Economics of the Process

Economic data are presented to permit the evaluation of the Wulff process, and to compare it with other methods of producing acetylene. Production levels have been selected at 20,000,000 and 40,000,000 pounds per year of acetylene with composition essentially as shown in Table 2.

A factor which bears great influence upon the result of any economic study is the investment required for a given installation. Fig. 4 shows the variation of estimated acetylene plant cost with acetylene production from three feedstocks—natural gas, ethane, and propane, each feed of approximately 95% purity.

These cost figures, which are for a plant on recycle operation, are the result of a detailed process design, and a detailed cost estimate. The acetylene plant cost expressed here represents the erected price, and is based upon predicted material and labor costs for the period until January 1, 1954.

This cost does not include the utility-producing facilities such as a boiler plant, water-treating unit, or cooling towers or such other facilities as a general office, laboratory, change house, gate house, warehouse, or machine shop. Inasmuch as the acetylene plant would be near the acetylene user, it is resonable to assume that the cost of these general service facilities would be borne proportionately

Clarence J. Coberly

Meet the Authors

Clarence J. Coberly is president of the Wulff Process Co. and has been associated with it from the time the Wulff process was just an idea some 30 years ago. He was graduated in Mechanical Engineering from Stanford U. in 1915. His first job was as a draftsman for Wilson and Willard Mfg. Co. designing oil field equipment, then for a short time with Southern California Edison Co. and later with California Compressed Gas, as chief engineer.

In 1924 he organized his own company, Kobe Inc., producing precision slotted oil well casing, using oxy-acetylene cutting in an automatic machine he developed. In 1945 Kobe Inc. became a subsidiary of Dresser Industries and he continued as president and general manager until recently, when he became vice president and director of research of the Kobe Division of Dresser Equipment Co., which permits devoting more time to the Wulff Process Co.

Marcel J. P. Bogart

Marcel J. P. Bogart, development engineer for the Lummus Co., has devoted full time to the Wulff process for the past year. He began this assignment back in April '52, when he went with other Lummus personnel to examine the process. Lummus signed a licensing agreement with Wulff, and Mr. Bogart plunged into the job of amassing knowledge and know-how about the process. He returned to Los Angeles last September and has spent the last five months at the pilot plant assisting in the experimental program.

Mr. Bogart was born in Paris, France and came to this country as a boy. He received his B. S. in chemical engineering from Cooper Union Institute of Technology in 1933 and a M. S. from U. of Michigan in 1934. He's been with Lummus since then as a process and senior engineer, and was recently assigned to the newly-created department of development engineering. He has concentrated on chemical plant projects. He assisted with the Port Neches butadiene plant, and has worked on ethylene and atomic energy installations.

Gerald R. Schiller

Gerald R. Schiller is another Lummus Co. process engineer. He received his Bachleor of Chemical Engineering degree from Cornell U. in 1944, then served two years in the U. S. Navy. In 1946 he went with Merck and Co., working on the development of new processes, and in 1951 joined the Lummus Co.

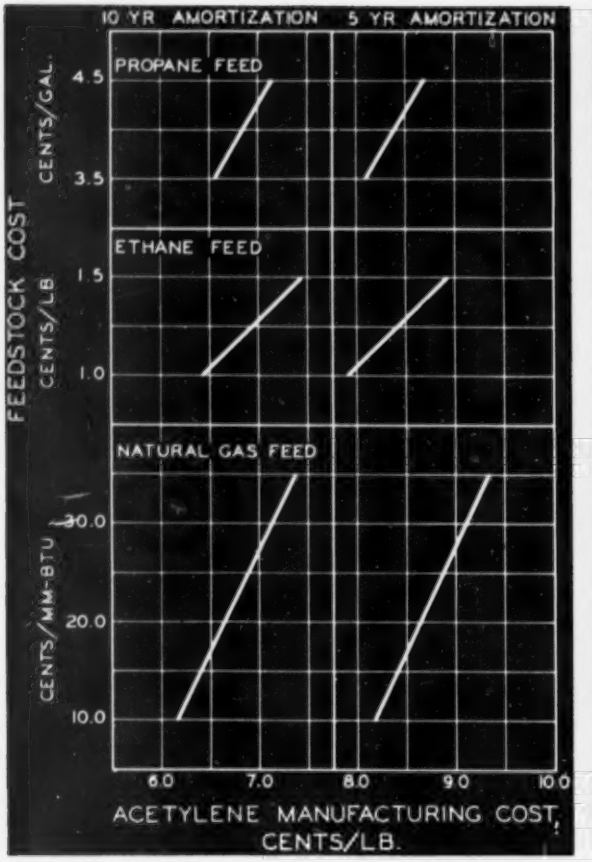


FIG. 5—Acetylene manufacturing cost vs. feedstock cost for a 20,000,000 lb./yr. plant

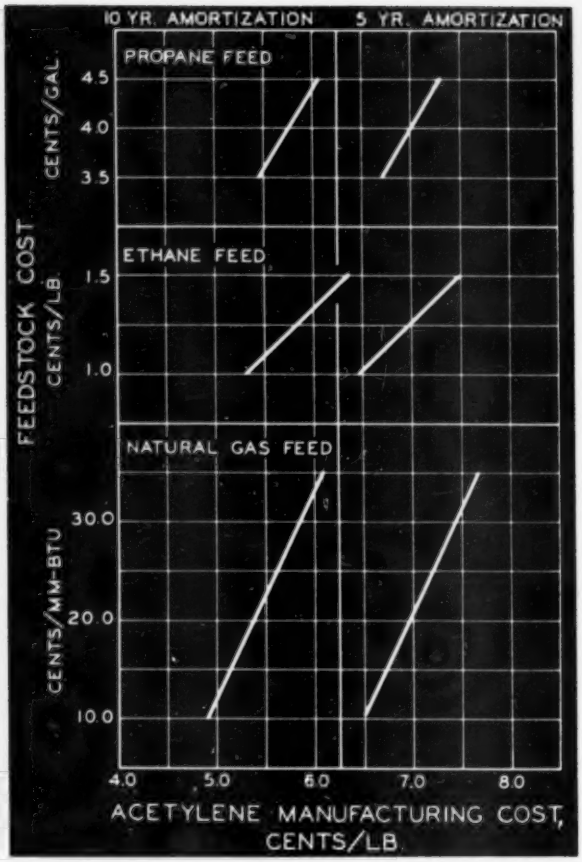


FIG. 6—Acetylene manufacturing cost vs. feedstock cost for a 40,000,000 lb./yr. plant

by the acetylene producer and its user. Further, these general service facilities would be subject to a longer amortization period than would the chemical plant itself.

Consideration must be given to the price and availability of the feedstock to be employed in the production of acetylene. Three typical and currently popular lower hydrocarbons —natural gas, ethane, and propane— have been chosen to illustrate the effect of choice of feedstock upon the unit manufacturing cost of acetylene. The price of each feedstock has been varied in turn to permit study of the effect both from a current and a long-range point of view. Fig. 5 shows the change of acetylene manufacturing cost with feedstock cost for natural gas, ethane and propane feeds for a production of 20,000,000 pounds per year of acetylene. Fig. 6 illustrates the same variation for a production of 40,000,000 pounds per year of acetylene. These plants are designed to operate 330 days per year.

Because accounting practice differs widely among manufactures, an additional variable, amortization period, has been included in this study. The effect of 5 and 10 year amortization periods may be seen in Figs. 5 and 6.

The manufacturing cost shown in this study includes only the charges shown in Tables 3-A and 3-B.

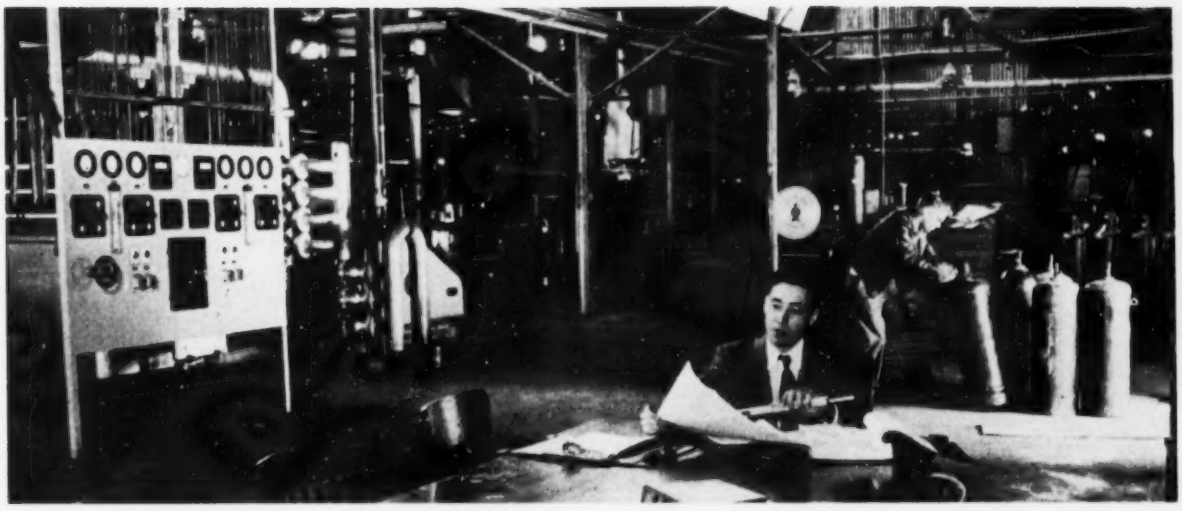
A raw materials and utilities summary is shown in Table 4 for a plant producing 20,000,000 pounds per year of acetylene. Off-gas after fuel requirements for the Wulff furnaces and process heaters are met is shown for each case. In the economic study, credit is taken for use of the resulting net off-gas as fuel. The steam generation facilities supplying the Wulff plant could consume this off-gas, thereby eliminating any problem of disposal.

The usefulness of the Wulff Process can lead to even more attractive economics where special or combination applications of this petrochemical process, as discussed earlier, are justified. Further, the high hydrogen concentration in the off-gas might make it attractive for synthesis gas use. Studies made of such operations indicate a reduction in the acetylene manufacturing cost.

Table 4—Raw Materials and Utility Summary

FEEDSTOCK	NATURAL GAS	ETHANE	PROPANE
Production, MM lb./yr.	20	20	20
Stream: High pressure, lb/hr.	62,000	35,400	45,100
Cooling Water:			
Quench System, gpm	1,200	1,000	1,600
Quench System Make-up, gpm	70	60	100
Exchangers, gpm	6,300	2,600	3,200
Electricity:			
Pumps, KWH/hr.	400	200	70
Precipitators, Lighting, Instruments, etc., KWH/hr.	120	120	120
Fuel Gas:			
Total Consumption*, MM BTU/hr.	81	44	45
Generated in Plant, MM BTU/hr.	170	68	93
Net Excess, MM Btu/hr.	(89)	(24)	(48)
Fresh Feed: To pyrolysis, MSCFD	5,234	1,570	1,377
Chemicals: Solvent Makeup, lb./yr.	8,500	5,500	5,500
Compressed Air: Instruments, SCFM	150	150	150
Inert Gas: Total Demand, SCFM	75	75	75

* at 75% overall efficiency



STRICTLY FUNCTIONAL is the word for this pilot plant at Maywood, Calif., where the Wulff Process has been developed. Seated at conference table is Mr. Bogart, Lummus engineer and co-author of preceding article. Behind him, to left, are regenerative furnaces, cooler, blower, quench tower, Cotrell precipitator and compressor. Moving cylinders to bottling area, right background, is plant operator Jack Hayes

Back of the Wulff Process

By FRANK BREESE
West Coast Editor

THREE men were the prime contributors to the development of the Wulff process—Clarence J. Coberly, Robert G. Wulff and Dr. R. Leonard Hasche. Of the three, only Mr. Coberly is now active in the process.

Mr. Wulff, for whom the company and the process were named, and Mr. Coberly were both working for the California Compressed Gas Co. in the early 1920's and it was during this period that the need for and the desirability of producing acetylene by pyrolysis of petroleum hydrocarbons was recognized.

In 1924 Mr. Coberly left the gas company to start his own business (Kobe Inc.) for producing perforated oil well casing and later hydraulic oil well pumps.

Soon after Mr. Wulff also left to spend full time on acetylene research under the direction and with the financial backing of Mr. Coberly and a small group of his associates.

Mr. Wulff was the first to recognize the great importance of the combination of low partial pressure, short contact time and rapid quenching of the cracked gas to obtain high acetylene yields. A number of important patents were issued to Mr. Wulff covering some of the basic features of this type of cracking. Laboratory scale cracking and later small pilot plant operations were carried out by him at the Kobe plant in Huntington Park, California.

In 1934 Tennessee Eastman became a licensee and further work was conducted at Kingsport under the direction of Dr. Hasche of that firm. Under this license further patents were assigned to Wulff Process Co.

Since then, Dr. Hasche has left Tennessee Eastman and is now a consultant in Johnson City. Mr. Wulff dropped out in 1928 and later withdrew from the field of physical science.

The first commercial plant was built at Maywood, Calif., and was put into operation in January, 1951.

Principal feature of the process is the regenerative furnace which is used instead of tubes to achieve cracking. Critics said the furnaces would not withstand the performance burden imposed on them, and that replacements and reconditioning would ruin the economics of the process. Last December the furnace at the Maywood plant was opened before an assembly of engineers for their inspection. It had been operating for 14 months. Findings have not been made public, but the Wulff people were impressed by the performance, which they felt vindicated confidence in the furnace. That was regarded as one of the highlights in the advancement of the process.

Another significant development was the installation of two new furnaces, in the Maywood plant, replacing the furnace just mentioned. Installation, begun in April, was completed in September, permitting continuous cracking.

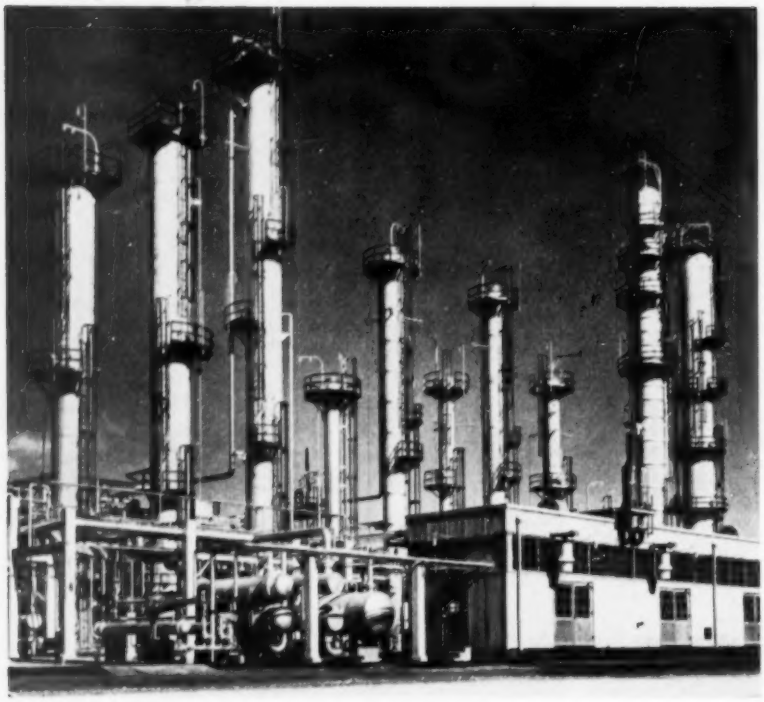
As a result, daily output has been quadrupled. It used to be 25 cylinders (each containing 17 lbs. or 270 cu. ft. of acetylene), is now up to 75, and is expected to reach 100 before long. When the output was 25, the venture was not economic. Now it's making money, and the developmental work can proceed without being a drain on the company.

In one corner of the L-shaped sheet-metal building is a small, plain office. This building houses the furnaces, compressors and the bottling section. In an empty area, a second-hand conference table has been moved in near the furnaces. At times the place is alive with engineers from the three license-holders (Fluor Corp., Girdler Corp. and Lummus), so they can drop into a handy chair at the table and make notes or hash over ideas.

Outside is the recovery section—columns of towers painted light green; a standard boiler, two small gasholders, a miniature cooling tower and two propane storage tanks. The site is in a teeming industrial zone on the east side of Los Angeles, on Randolph St., a block west of Eastern Ave.

The big problem that has held up the process has been economics. Satisfied that the process has a good future, the license-holders already are publicizing economic aspects: 1 to 2c per pound cheaper to produce than using calcium carbide; less hazardous; less of a waste disposal problem; geographical flexibility (calcium carbide process consumes huge quantities of electric power and requires shipment of raw materials to hydroelectric areas).

In the meantime, Mr. Coberly is still optimistic for the ultimate success of the process—and still possesses a twinkling sense of humor. When PETROLEUM PROCESSING asked him about his early career, he replied that he started with Wilson and Willard as an engineer. "I was the chief engineer," he said, and then added, with a smile, "As a matter of fact, I was the only engineer they had."



GENERAL VIEW of new Platforming and Udex units at Cosden's Big Spring, Texas, refinery. Left to right, columns visible are: platformate stabilizer, prefractionator, charge splitter, reactor charge stripper, toluene column, light straight-run gasoline stabilizer, benzene and xylene columns, solvent stripper and Udex extractor

First Complete Udex 'B-T-X' Plant Makes Nitration-Grade Products

By D. P. THORNTON, Jr.
Southwestern Editor

THE first installation of a complete system for the recovery of petroleum benzene, toluene and xylenes in a single, continuous operation was unveiled to oil men at an "open house" at the Big Spring, Texas, refinery of Cosden Petroleum Corp. It marks one more step in the history of this Independent oil company towards diversification into the petrochemical field, in addition to the usual line of refined oil products.

The $3,181,000 installation at Big Spring (15% less than originally estimated) consists of a nominal 4500 b/d UOP Platforming unit for synthesis of aromatics and straight-run gasoline upgrading and a nominal 1650 b/d Udex unit for aromatics recovery.

The set-up of the Cosden refinery is such, however, that this installation could not have been justified solely from the upgrading of gasoline blending stock. Revenue from the petrochemicals produced was the deciding factor, while improved gasoline quality is "velvet," relatively speaking.

The outstanding feature of the Cosden installation from the petrochemical standpoint is the recovery of the three low-boiling aromatics from a single extraction step for this fraction and the subsequent separation of each of the three aromatics in nitration-grade purity without rerunning. There are no slop-cuts of benzene-toluene or toluene-xylene to be reprocessed. A deliberate change has been made in operation to produce more bottoms from the xylene tower for sale as a chemical intermediate. This is the only fraction which might be termed a "slop cut" from the entire chemical recovery operation on the Udex unit.

As in the one other installation of this general type known to have been completed so far,[1] the Cosden installation consists first of the UOP Platforming process, employing a platinum - containing catalyst to achieve dehydrogenation of naphthenes in the feed along with hydrocracking of heavy hydrocarbons and isomerization of paraffins and naphthenes. There also is some direct aromatization and virtually complete desulfurization.

Operated in block following generally a scheme originally discussed by Read,[2] this unit alternately produces an aromatic heavy naphtha blending stock for high quality gasoline from low-octane straight-run, and the feed stock for aromatics recovery.

Second component of the installation is the Udex recovery system, which makes use of the selective solvency of the diethylene glycol-water system for aromatic hydrocarbons to effect their separation from paraffin hydrocarbons in the same boiling range. Thereafter, the recovery consists of stripping the aromatics from the solvent and separating benzene, toluene and xylenes by precise fractionation.

Platformer Operation

The Cosden refinery processes a mixture of West Texas crudes at a normal rate of 25,000 b/d. (On occasion this has been increased to 27,800 b/d.) From this is produced straight-run gasoline, kerosine, JP fuel, home heating oils, diesel fuel, gas oil for catalytic cracking, heavy fuels and asphalt products. Thermal cracking also is utilized. In addition, various mercaptans are recovered from caustic methanol extraction of thermal gasoline for sale as odorants and chemical intermediates. These refinery operations have been previously described in detail.[3]

Insofar as the Platformer is con-

cerned, the charge consists of total straight-run gasoline below 400 end-point as produced in topping operations and desulfurized by the hot clay process to a sulfur content of approximately 0.02 wt.-%. At the Platformer the charge is first depentanized. The overhead C_5 and lighter is subsequently depropanized in the same stabilizer which takes the overhead material from the platformate stabilizer. These products are used for other purposes elsewhere in the refinery.

The straight-run feed next is split into an overhead 150-270° F. cut and a bottoms 270-400° F. fraction; the former is feed for aromatics production and the latter to be upgraded for motor gasoline blending. Both are sent to intermediate floating-roof storage for running as blocked operations on the Platformer dictate.

The light fraction contains 8-9 vol.-% of C_6-C_8 aromatics, including 1.2% benzene and 5% toluene. The heavy naphtha fraction contains up to 20% aromatics.

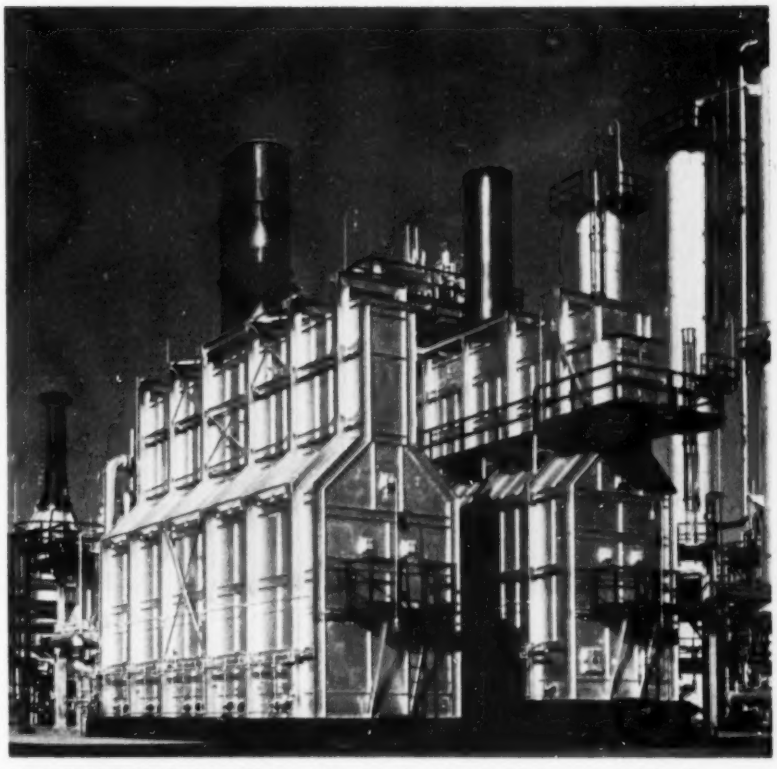
Balancing motor fuel operation with aromatics production, the charge to Platforming for motor fuel production amounts to approximately 4800 or 4900 bpsd. For aromatics operation the charge to the unit is approximately 3300 bpsd.

In each case the processing conditions are varied to favor aromatization or increased hydrocracking. In general, temperatures in the 900-950° F. range and low pressures favor aromatization, whereas higher pressures and somewhat lower temperatures favor hydrocracking. Hydrogen is of course present in the recycle gas to the unit at about 90-92%; this stream is not treated for hydrogen sulfide removal because of the low sulfur concentration in the charge stock and the high recycle ratio used.

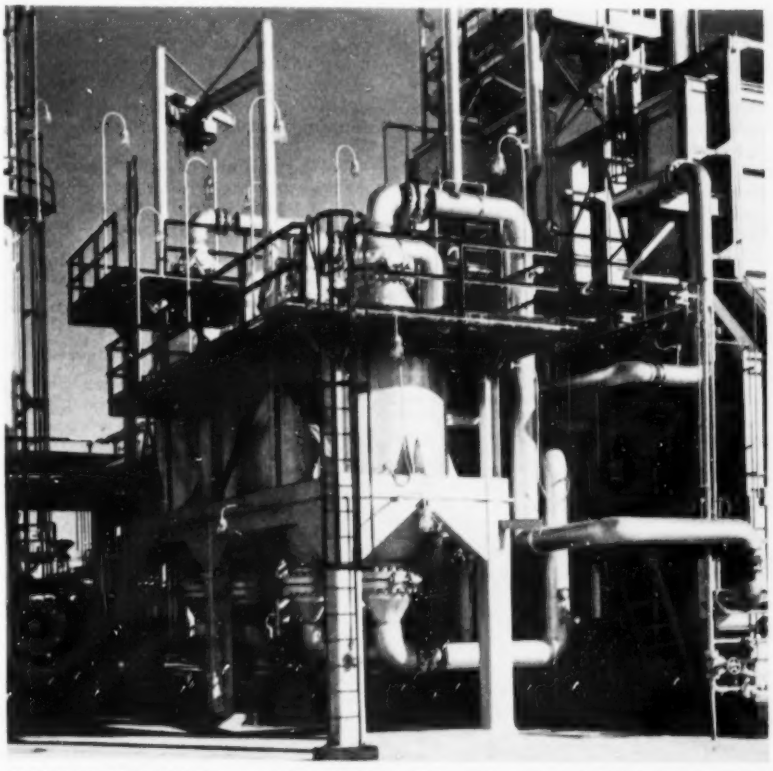
A schematic flow diagram of the operation is shown in Fig. 1. From this it will be noted that an additional stripping operation is used to clean up fractions following feed splitting. The addition of recycle hydrogen occurs just before the charge enters the feed heater. Following Platforming, the product is freed of gas and then stabilized, the product running to storage either as motor fuel blending stock or as charge for aromatics recovery. The overhead from the Platformate stabilizer is run to the light straight-run stabilizer during the aromatics operation for recovery of pentanes.

Aromatics Recovery

Essentially the Udex portion of the unit consists of an extractor and solvent stripper, a water wash, heater and contact clay treater, and three towers for recovery of the respective aromatics. Only one extraction step



PLATFORMER HEATERS, with solvent stripping heater in left background. Towers of Udex unit at extreme right



FOUR REACTORS in Cosden's Platforming unit for synthesizing aromatics and upgrading straight-run gasoline

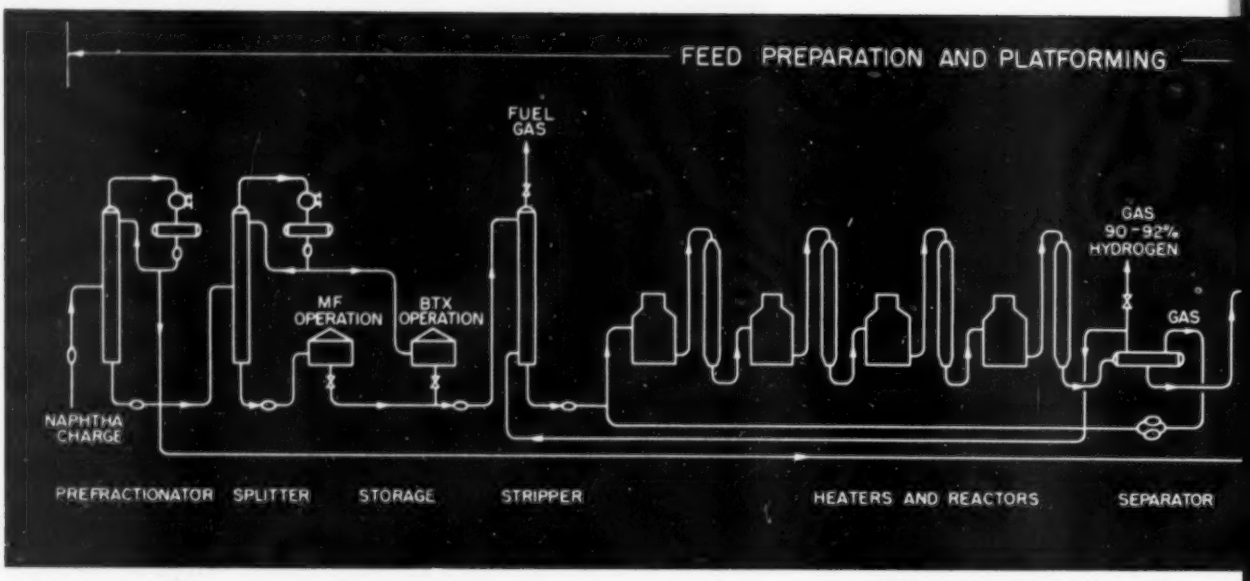


FIG. 1—Flow diagram of Platforme

is used although conventional practice with other solvents heretofore has involved splitting the aromatics fraction into two or more cuts and separately extracting these.

Cosden uses a special tray extractor, the design of which was developed by UOP. Details are not available. In general, the charge rate is set to balance inventory for continuous operation and the stream is introduced at approximately the middle of the extractor. The hydrocarbons mix with the solvent countercurrently. The selectivity of the glycol-water system is primarily dependent on the water content which normally ranges from 8 to 10% in Cosden's operation and is relatively insensitive to temperature. Thus, extraction temperature can be kept near that required for subsequent stripping, so long as vapor pressure of the charge is not exceeded at the extractor pressure selected.

The aromatic-rich solvent leaves the base of the extractor; the overhead is substantially free of aromatics. Tests made on charge and product from this operation during three separate periods indicate the yield of total aromatics to be 94% or higher of the aromatics present in the raw charge to Platforming or producible from the naphthenes originally present.

In the stripper following the aromatics are taken overhead and the bottoms returned to the extractor.

One of the things which makes difficult the recovery of individual petroleum aromatics in high purity from the total aromatic product without preliminary fractionation, azeotropic distillation or other processing is the coexistence of paraffinic or naphthenic hydrocarbons having the same boiling point or differing by only a few degrees. Thus, product quality depends on the efficiency of the conversion process and also the selectivity of the solvent for the desired aromatics. This greatly simplifies the fractionation problem.

Cosden produces benzene, toluene and mixed xylenes in purities meeting nitration grade specifications.

Following stripping and washing, the aromatic extract is heated and given a treat with contact-type clay. This step is used to insure that the petroleum-derived benzene will meet the acid-wash color test required of nitration-grade material. That this has very little effect on the charge is evidenced by the fact that over 8100 bbls. of liquid are treated per ton of clay. Since its life is long and cost low ($35/ton) no attempt is made to regenerate this clay.

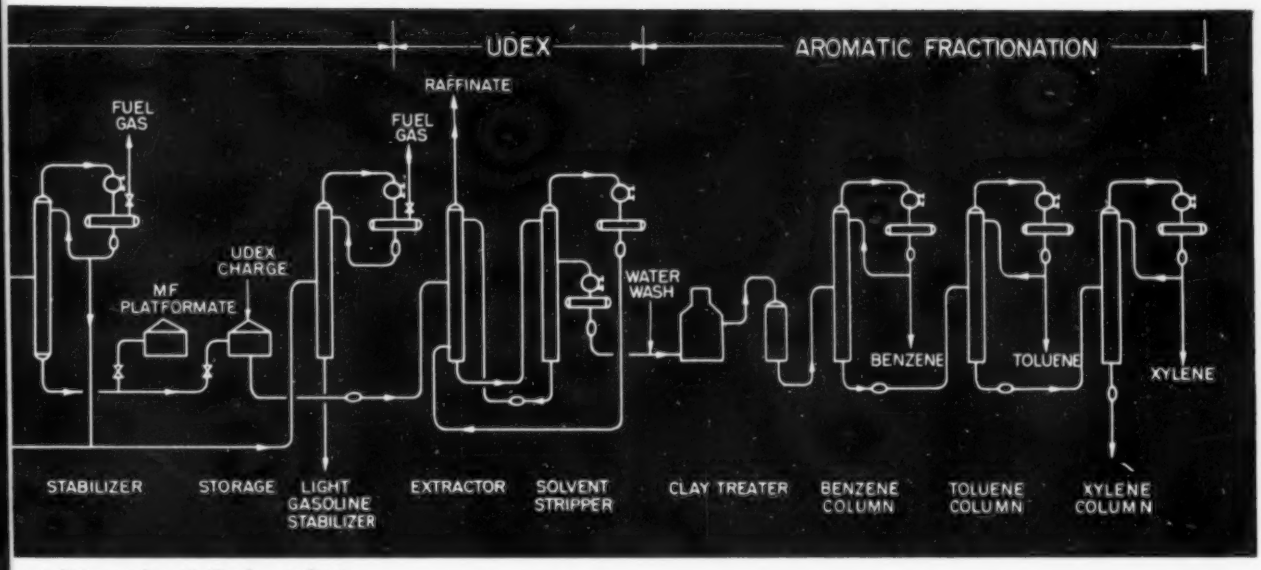
The separation system consists of three bubble towers in series, in each case taking benzene, toluene or xylenes as overhead product. The successful operation of these towers presented an unusual control problem, as is obvious from the fact that 0.1% of toluene in the benzene will cause failure in meeting nitration-grade specifications. A similar situation exists for benzene or xylenes in the toluene.

This is achieved by the use of what is called a "composition controller," developed by Universal Oil Products Co., operating upon material from

Table 1—Inspection of Aromatic Products from Udex Unit with Nitration Grade Specifications

	Benzene		Toluene		Xylene	
	ASTM Nitration Grade Specs.	Udex Product	ASTM Nitration Grade Specs.	Udex Product	ASTM Nitration Grade Specs.	Udex Product
Specific gravity	0.8820-0.8860	0.8849	0.8690-0.8730	0.8724	0.8650-0.8700	0.8724
Color	*	Passes	*	Passes	*	Passes
Solidifying point, °C.	>4.85	5.49	....	....	....	....
Acid wash color:						
Acid phase	<2	0	<2	0+	<6	0+
Hydrocarbon phase	No change	Passes	No change	Passes	No change	Passes
Acidity	No free acid	Passes	No free acid	Passes	No free acid	Passes
Sulfur compounds	Free of H_2S & SO_2	Passes	Free of H_2S & SO_2	Passes	Free of H_2S & SO_2	Passes
Sulfur, weight %	....	....	....	....	....	0.0008
Copper corrosion	**	Passes	**	Passes	**	Passes
100 Ml. Distillation:						
Range, °C.	<1	0.6	<1	1.0	<3	2.6
Included temperature, °C.	80.1	Passes	110.6±0.1	Passes	139.3	Passes
Initial boiling point	....	79.8	....	110.2	....	139.0
10%	....	80.0	....	110.4	....	139.2
50	....	80.1	....	110.8	....	139.8
90	....	80.2	....	111.0	....	140.4
End point	....	80.4	....	111.2	....	141.6

* Not darker than solution 0.0030 g. $K_2Cr_2O_7$ in one liter of water.
** No iridescence or discoloration.



and Udex units at Cosden refinery

one of the top trays to control reflux rate. In practice, this control compares under column conditions the vapor pressure of the pure component desired with the vapor pressure of the liquid on the tray through the medium of a Foxboro D/P cell. An otherwise conventional instrument controls the reflux rate accordingly. Control thus is independent of barometric pressure.

Bottoms from the xylene column, consisting of a small amount of xylenes, along with heavier aromatics, is the only "slop cut" of the system. Originally intended for incorporation in motor gasoline, the volume of this product has subsequently been increased from just a few barrels daily to approximately 50 b/d by suitable adjustment of the Platformer fed splitter. The material is being bought by chemical companies for an undisclosed purpose at a reported price nearly equivalent to that brought by the nitration-grade xylenes mixture.

At the present time, recoveries of the aromatics include 130 b/d of benzene, 300 b/d of toluene and 390 b/d of xylenes. The volume of xylene bottoms varies between 35 and 50 b/d. Total overall liquid shrinkage on the basis of charge to Platforming is approximately 8%, and is largely represented by hydrogen and fuel gas formation. Naphthene conversion has consistently exceeded 90%.

Among other interesting statistics is the catalyst charge to the Platformer of 8583 lbs., with a life already exceeding 50 bbl. of charge per pound of catalyst. Approximately 22,000 gal. of diethylene glycol was used to fill the Udex system. Loss figures are not available due to the fact that a considerable accumulation of weak aqueous solutions has not yet been processed for glycol recovery.

Table 2—Isomeric Distribution of Xylenes for B-T-X Plant*

	Composition, Vol.-%			B.P., °C.
	Design	Actual		Pure compound
Toluene	<1	<1		110.6
p-Xylene	20	18	Boiling Range 2° C	138.3
m-Xylene	45	39		139.1
o-Xylene	20	24		144.4
Ethylbenzene	15	19		136.2
Higher aromatics	0	0		>145
	100	100		

* See Table 1 for ASTM Nitration Grade specifications and inspection of Udex xylenes product.

Aromatic Products Quality

An inspection of the aromatic products as currently produced is presented in Table 1, together with nitration grade specification requirements for the three chemicals. The benzene passes requirements with a comfortable margin, and while coming a bit closer to some limits, the toluene also passes readily. In the case of xylene, the petrochemical product in general has a specific gravity close to the specification maximum or exceeding it slightly. This is an indication of high purity, however, and shows a somewhat greater concentration of ortho-xylene and ethylbenzene in the mixture than was contemplated for the coal-tar product composition against which the specification was originally drawn.

A comparison of design distribution of the xylene isomers in the mixture against actual composition as shown by a recent spectrometer analysis is given in Table 2. It is apparent that the actual product contains less meta and para isomers than was predicted from the original charge stock analysis. There also is more orthoxylene and ethylbenzene. This difference probably accounts for the xylene mixture meeting nitration-grade specifications with a boiling range between 2.5 and 2.7° C.

Now under consideration by Cosden's management is further diversification into the chemical field. There is enough recoverable hydrogen in the Platformer gas vented to the plant fuel system at present to support a synthetic ammonia plant of up to 30 tons per day capacity. Also, elsewhere in the refinery is vented a considerable amount of hydrogen sulfide. A survey is under consideration to determine the feasibility of ammonia production and sulfur recovery and perhaps it may prove possible to carry operations into the chemical fertilizer field. Also, the possibility of segregating the three xylene isomers via the fractional crystallization and distillation route is tempting.

Because Cosden now has at hand two of the most important fundamental chemical building blocks, aromatics and olefins, many other interesting possibilities exist in supplying the continuously-expanding demands of the petrochemical industry.

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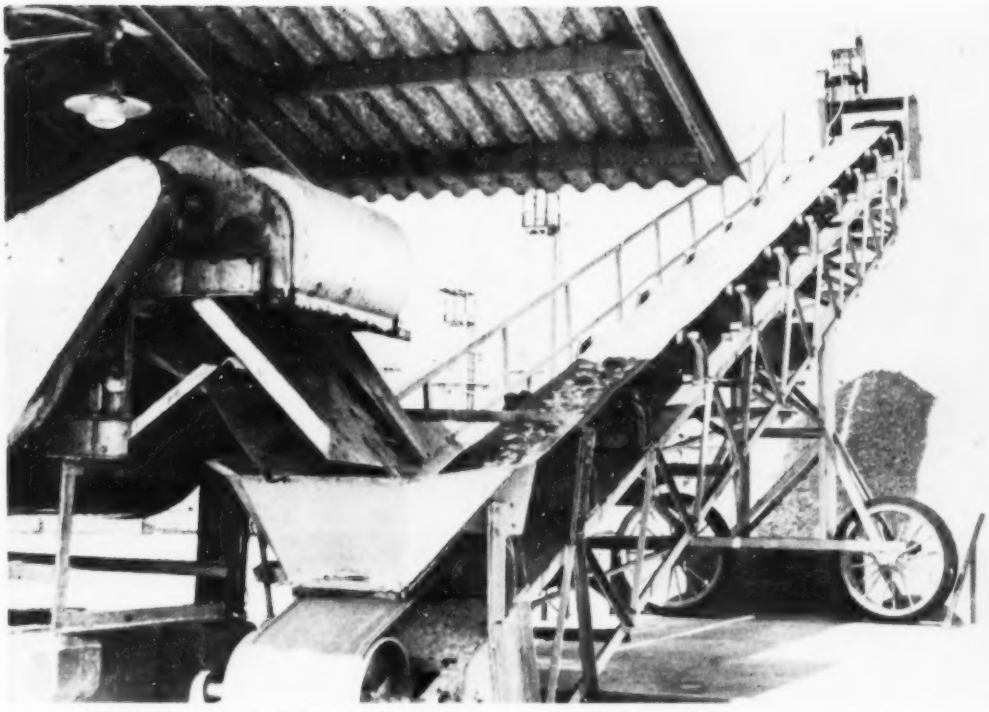


MOBILE CONVEYOR takes flaked sulfur produced at Mexico's Poza Rica gas plant and moves it to pile. Conveyor can also be positioned for loading directly into trucks.

Sulfur via the Belt Line

Endless conveyors move product from convertors to storage in Mexican sulfur-from-gas plant

By D. P. THORNTON, Jr.
Southwestern Editor

MEXICO'S only substantial petrochemical operation, 120 tons per day of sulfur recovery, is carried out in conjunction with natural gas sweetening operations and crude stabilizing facilities at the Poza Rica plant of Petroleos Mexicanos. The gas processing facilities there are described in detail in the article, "Crudes are 'Tough' to Handle," beginning on p. 373 of this issue.

The natural gas from Poza Rica crude production operations is extremely acid, containing 4 vol.-% H_2S and 17% CO_2 for a total of 21 vol.-%. The corrosive effects this can have on equipment are readily imagined. At the plant the 60 psi. field gas is boosted to 325 psi. without pre-treatment and the 280 psi. high pressure gas likewise. The volume amounts to approximately 109,000 Mcfd.

The sweetening plant which receives this gas consists essentially of two Girdler units in parallel, each designed for 60,000 Mcfd. and employing an aqueous 20% solution of monoethanolamine as the active agent. The processing sequence is conventional, the gas being contacted countercurrently with MEA and the sweetened gas then being returned via a scrubber to the suction stages of additional compressors prior to natural gasoline recovery. Sour liquid hydrocarbons trapped from compressor scrubbers on the high and low pressure gas streams are combined and similarly sweetened in a small liquid-phase DEA tower. The MEA is steam-stripped in identical vessels to regenerate it for re-use.

Designed for 18% Gas

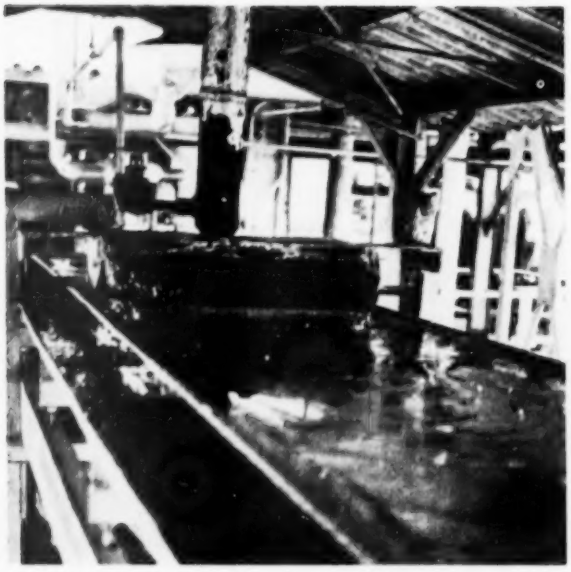
An interesting point about this unit is that it originally was designed to sweeten an 18% acid gas. However, in processing the 21% acid gas it reduces the H_2S content to less than 10 grains per 100 cu. ft. with substantially no CO_2. The stripping steam requirement (partly generated by waste heat in sulfur recovery) is 200,000 lbs. per hour of 80 psi. steam. Water is condensed out of the overhead gas.

When the unit first started operating in January, 1951, the amine consumption was in excess of 2 lbs. per million cu. ft. of treated gas; at present this is 0.8 lbs./MMcf. The improvement in chemical consumption is due largely to the installation of more efficient mist eliminators (of the Metex stainless steel type) in the top of the stills and employment of "Ocenol" as an anti-foaming agent.

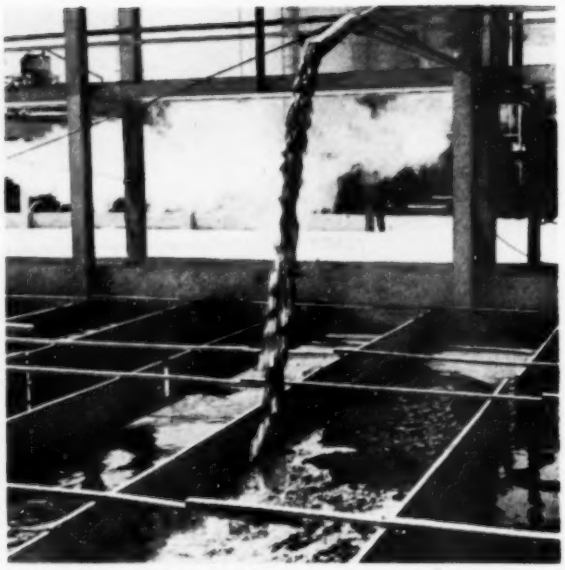
The still overhead gas is charged directly to a sulfur recovery plant

Petroleum in Mexico

This article on the recovery of sulfur from natural gas in Mexico is part of a series on the petroleum processing industry in that country, based on a seven weeks tour of plants there by the author. The first article appeared in the February issue ("Modern Refining in Mexico," p. 217). Another appears elsewhere in this issue, and additional ones will be published in later issues—all dealing with specific installations.



MOLTEN SULFUR is deposited on 320-ft. endless stainless steel belt, running in contact with water in cooling trough below. At "end" of belt, solid sulfur is flaked off.



EMERGENCY BIN COOLING can be used when stainless steel belt is shut down for maintenance or repairs. Two bins are available, each holding 2-days sulfur output.

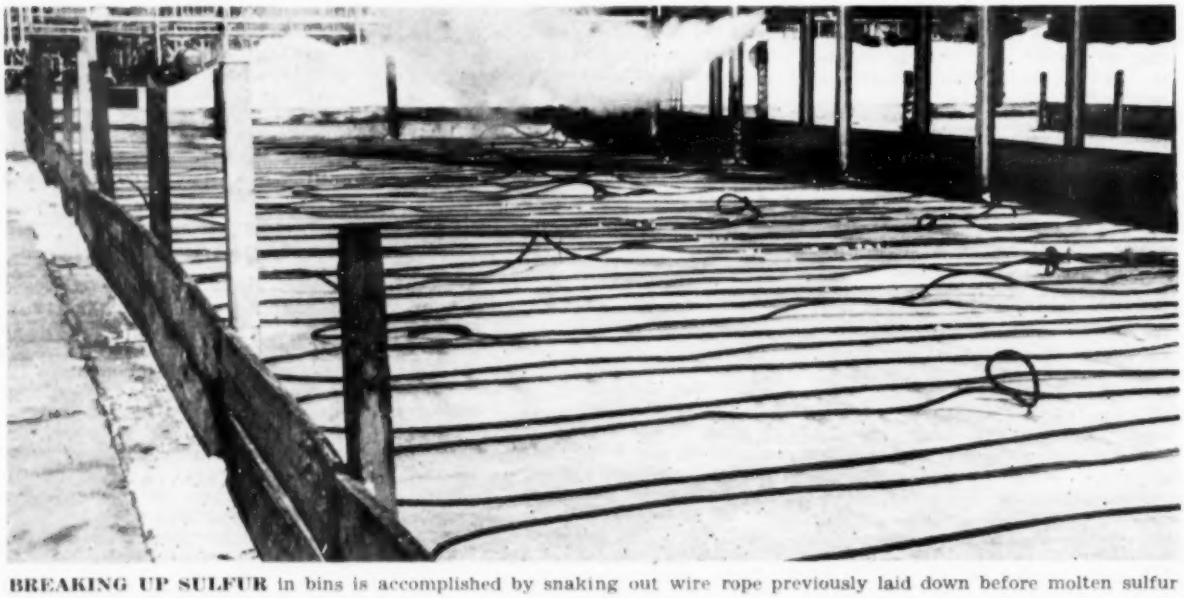
designed by General Chemical Co. for Pemex. For this reason the stills are equipped to produce two acid-gas streams of 40% and 15% H_2S, respectively. Pemex's operators, however, determined experimentally that this was unnecessary at Poza Rica. Satisfactory operation could be obtained if all the acid gas was substantially the same H_2S concentration. The unit now is operated to produce a difference in acid gas content for the two streams which rarely exceeds 1% and simplifies control of both operations.

The sulfur plant is not greatly different from U. S. plants in most respects except for its large size—120 tons per day. Until only recently it was the largest sulfur-from-natural gas plant in the Western Hemisphere. The sulfur is 99.9% pure (or better) and involves the treating of 21,200 Mcfd. of acid gas.

Sulfur Recovery Operations

The process involves the basic Claus reaction of oxidizing one-third of the H_2S to SO_2, then combining this with the remaining two-thirds of the total acid gas stream to effect the reduction to elemental sulfur. Originally, it was intended to burn the required amount of the 40% H_2S gas stream with air, combining the reminder with the 15% H_2S stream for the reduction. Now, the two H_2S streams are 15-16% acid gas. The secret of control in either event is, of course, in precisely regulating the oxygen-to-H_2S ratio.

Following combustion of the initial third, the remainder of the acid gas is introduced into the after-part of the furnace. The results are not



BREAKING UP SULFUR in bins is accomplished by snaking out wire rope previously laid down before molten sulfur

only to preheat this portion of the acid gas, but cool the hot SO_2 and here, it is reported, about 60% of the reduction to elemental sulfur occurs before the gas emerges from the furnace. Even so, the reaction mixture leaves the furnace at 1382° F., requiring final cooling to the catalytic converter temperature of 446° F. in a waste-heat boiler which generates 60,000 lbs. per hour of 275 psig. steam. Water can be injected also when necessary as further temperature control. (Excessive water injection is of course undesirable from a process standpoint. The charge gas already was saturated since there is no dehydration step following amine regeneration.)

The two catalytic converters employ bauxite as the conventional catalyst. Outlet vapors from the first are scrubbed with molten sulfur at 392° F. to condense the sulfur. This gas then is reheated to conversion temperature with by-passed 1382° F. gas from the furnace outlet and charged to the second converter where the reaction is substantially completed; the sulfur being scrubbed out as before.

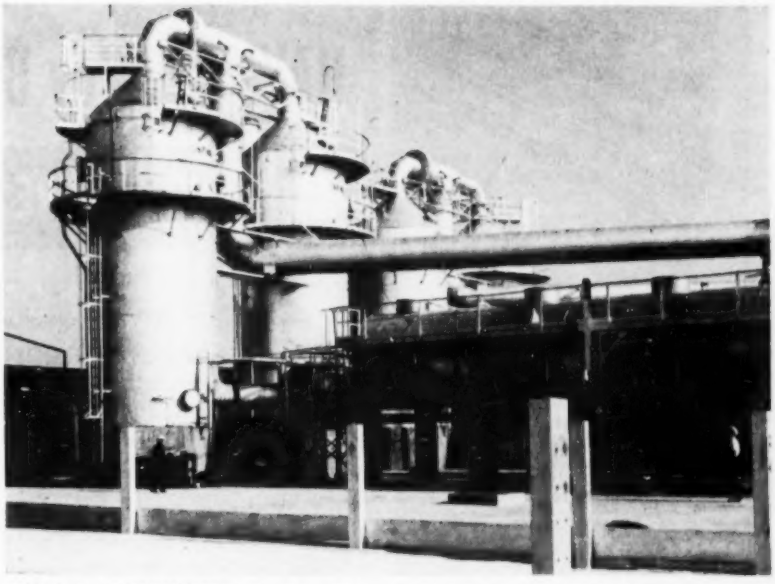
Pemex's engineers have added a third step since the plant was built. Preheated air is added to the residue gas and the mixture passed through a third (small) converter in order to assure that no unreacted H_2S remains in the tail gas. There is further assurance also that no combustible gas remains in the residue to the stack.

Use Novel Flaking Method

A novel method of converting the sulfur to an easily-handled flake form is used at Poza Rica. The more common method used in similar U. S. plants of dumping the molten product into bins for solidification is available strictly as an emergency procedure.

At Poza Rica a side-stream from the pumps circulating molten sulfur over the scrubber towers is further cooled by exchange with water and discharged into a hopper, where it flows through nozzles onto a moving belt of polished stainless steel, 30 in. wide. This has raised edges of rubber to confine the liquid sulfur and is 160 ft. between pulleys. For the first 120 ft. after the sulfur is deposited the belt runs with its lower surface in contact with a bath of cold water, after which air-cooling is depended upon for the remainder of the journey.

A scraper at the "end" of the belt removes the sulfur in a continuous sheet, which then is led into a breaker which functions like the familiar household ice-crusher. The resulting flakes, approximately 2 sq. in. in area and about a quarter-inch thick, fall on a mobile inclined conveyor belt of rubber-coated canvas which makes a neat semi-circular pile of the yellow element. As this pile grows the conveyor is moved elsewhere in the storage yard by mobile equipment, or can be positioned for loading directly into trucks.



SULFUR SCRUBBERS in Poza Rica sulfur recovery plant. Long vessel at right is No. 1 catalytic conversion chamber, where reduction to elemental sulfur is 90% complete.

A valuable operating kink was developed here because the molten sulfur at first had the annoying tendency of adhering tightly to the stainless steel belt. This caused too many emergencies in the early days of operation. Like most such schemes the solution was simple enough: spray the belt with water immediately ahead of the molten sulfur hopper.

The small amount of adherent water forms steam when passing under the molten sulfur, the cooling forming enough "skin" on the sulfur to minimize adhesion since the belt is cooled by the water bath on the other side. This also has resulted in sharply reduced wear on belt and scraper, because the sheet of sulfur now literally cracks off the belt on reaching the knife.

When the flaker is out of service, due to emergencies or for other reasons, two 2-ft. deep wooden-wall bins have been provided to accept the molten sulfur. Either will hold two days' production. Their use was a double-barreled headache in the early days of operation, however, because this meant a crew with pick-axes to get out the sulfur and another gang to load trucks. Blasting was out of the question on several counts, but principally because the bins are immediately adjacent to both the sulfur and sweetening units, making intolerable the fire hazard and the effects of the concussion on control instruments as well as operators.

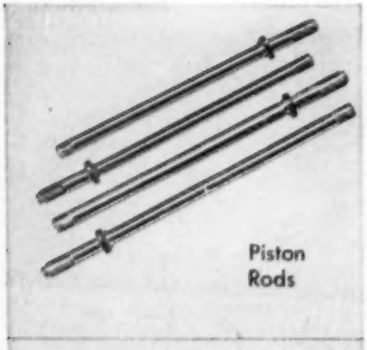
The solution to this dilemma was the laying of a wire rope in the bottom of the bins in a zig-zag fashion, carrying one end out of the bin. When this rope is snaked out by a winch truck the sulfur is quickly and effectively broken into chunks of manageable size, easily handled by one man.

From the practical standpoint it is advisable to protect personnel from flying bits of sulfur during the snaking process. They should also remain well back until it is determined that there are no "hot spots" of still-molten sulfur remaining in the center, to be flung considerable distances as the rope is pulled free.

Laid Out for Maintenance

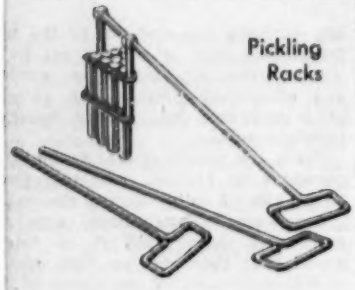
The installation is well laid out, without evidence of overcrowding. Drives are primarily electric with steam spares only for essential services. Considerable emphasis has been made with respect to accessibility for easy maintenance. Crane arms are permanently installed on the top of structures supporting major towers and the major elements of the twin units are seperated by a road. At the sides of this road are tracks to accommodate a mobile A-frame used to handle heavy pieces of equipment during turn-arounds.

The sweetening and sulfur recovery plants generally are brought down for maintenance and inspection every six months. Being independent, it is possible to take one MEA twin at a time, thus assuring a continued flow of fuel gas to the Atzcapotzalco refinery. When both MEA units and the sulfur plant are down, approximately 20 days is required for turn-around. It also is possible to take the sulfur plant down without disturbing sweetening operations, in which case all acid gas is flared.



Piston Rods

Bolts



Pickling Racks

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HAYNES alloy bars can be turned, ground, drilled, tapped, reamed, threaded, and welded.

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(To obtain more data on advertised products see page 424)

PLANNING PETROCHEMICAL DISPLAYS for the International Petroleum Exposition are Miller W. Conn (right) chairman of the subcommittee, and Robert Douglass

IT'LL BE OVER THERE! Petrochemical sub-committee member Leroy Donald shows Hall of Science to visiting committee members Isaac Drogin (left) and John Britton

Petrochemicals at Oil Show

THE magic of chemicals derived from petroleum and the great technical strides which have come in refining oil itself since 1948 will get a big play in the Hall of Science exhibits during the International Petroleum Exposition at Tulsa, May 14-23.

They aren't the only fields of oildom which have made rapid advances during this period, of course. All of them will be on display in the order of their occurrence in the industry, beginning with geology and ending with manufactured products ready for the ultimate consumer.

The petrochemical exhibits will be engineered to attract special attention. Under the chairmanship of Dr. Miller W. Conn, manager of market development for Phillips Petroleum Co., the petrochemical exhibit subcommittee is getting together a display which will give visitors an "inside" look at the diversity of products in this field, as well as their effect on modern living.

The theme and purpose of the exhibit will be to pin down, in the minds of oil people not already in the "know" and the lay public alike, that the oil industry does much more than provide gasoline and lube oils, furnace and industrial fuels. Petrochemical exhibits all will be grouped together under present plans plus also several movies (to be run in the theater, but not in the petrochemical exhibit area).

Current plans visualize nine exhibits, varying somewhat in size, and involving dioramas, conventional displays and, probably, audience participation via push-button to some extent. These include:

Synthetic fibers.

Synthetic rubbers.

Carbon blacks (in part this overlaps with synthetic rubbers).

Plastics (also including protective coatings made from them).

Nitrogen fertilizers and other agricultural chemicals (such as herbicides, defoliants and repellants).

Sulfur and sulfur chemicals.

Detergents.

Solvents (other than pure hydrocarbons or hydrocarbon cuts, such as ketones, esters and the like).

Chemical intermediates made from petroleum, including some mention of additives.

The methods used to manufacture these various petrochemicals likely will not be shown—not that they are so secret but principally because they are apt to be meaningless or even confusing except to the specialist. Instead, they will tell the visitor what many of these products are, how they look and where they fit into the pattern of his daily living.

Thus, the man who gets in his automobile will realize petrochemicals played a part in the seat-covers of his automobile and the foam-rubber in the upholstering as well as in the tires on which it rides.

The soap he uses to clean his hands may be in part petroleum-derived, and the plastic plates from which he eats a picnic lunch had their origin in an oil or gas well.

The fertilizer which helped produce the food he eats likewise came from gas and oil, as did the insecticides used to protect the growing plants in the fields.

And, finally, even the paint on his house owes part of its characteristics from petrochemicals.

Working with Mr. Conn in the preparation of the petrochemical exhibit to be made possible through the cooperation of many of the firms engaged in this field will be: Leroy Donald, manager of the chemical sales division, Lion Oil Co., El Dorado, Ark.; Dr. Isaac Drogin, research director, United Carbon Co., Inc., Charleston, W. Va.; John A. Britton, Jr., director, Enjay Co., Inc., New York, and Robert A. Douglass, regional sales manager, Ethyl Corp., Tulsa.

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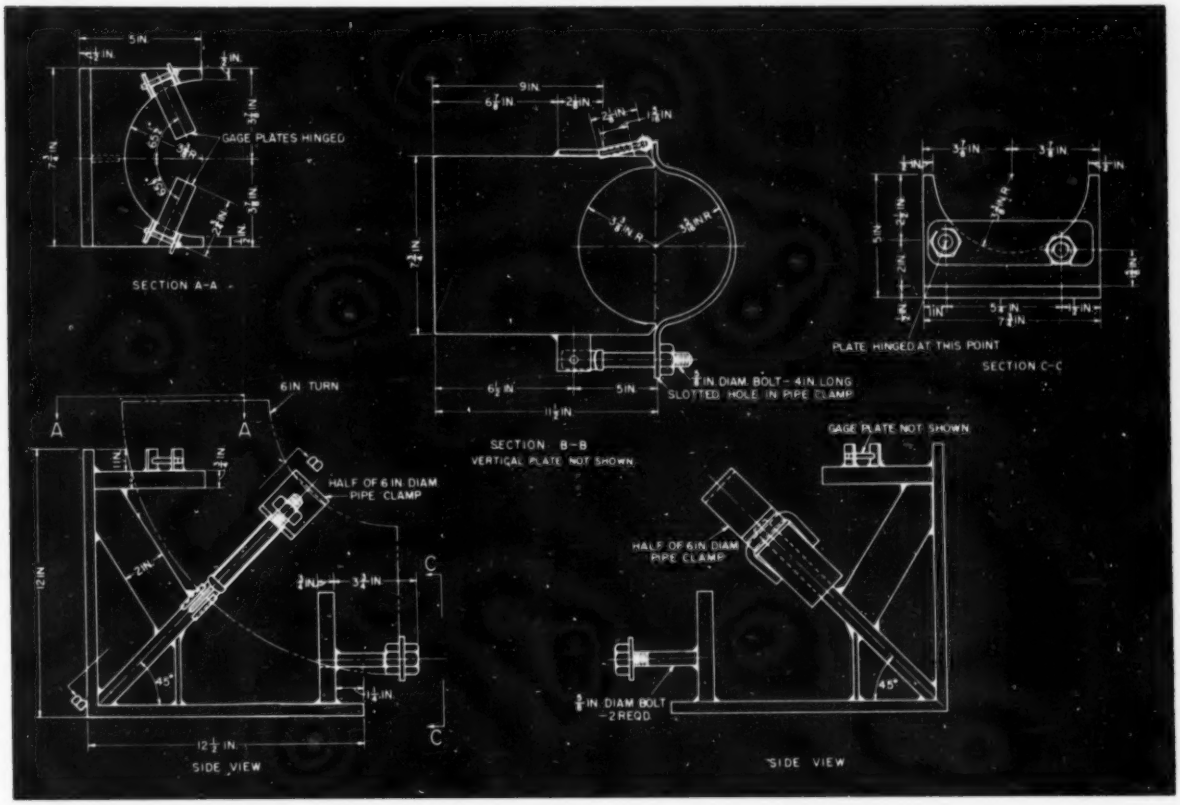
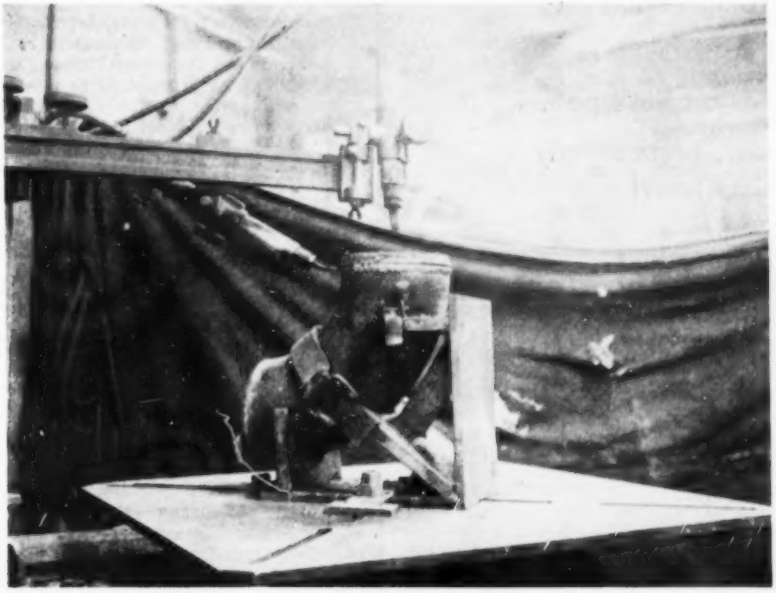

GAGE PLATES HINGED
SECTION A-A
PLATE HINGED AT THIS POINT
SECTION C-C
⅝ IN DIAM BOLT - 4 IN LONG
SLOTTED HOLE IN PIPE CLAMP
SECTION B-B
VERTICAL PLATE NOT SHOWN
6 IN TURN
HALF OF 6 IN DIAM PIPE CLAMP
GAGE PLATE NOT SHOWN
⅝ IN DIAM BOLT - 2 REQD
SIDE VIEW
SIDE VIEW

CONSTRUCTION DETAILS of jig for cutting weld fittings

Jig and Weld Positioner Speed Salvage Jobs



TWO TORCHES are on the positioner; one for cutting and one for beveling

SALVAGING welding ells and pipe flanges from scrap pipe is greatly facilitated at Esso Standard Oil Co.'s Baltimore refinery by use of jigs and a two-torch, welding positioner. The method is useful for reclaiming usable fittings which have been rough-cut from disassembled lines, etc., with perhaps one inch of pipe still attached. Jigs and machine are illustrated in the accompanying drawings and photographs.

In use, the jigs for the weld ells are center-mounted on the turntable of the "Ransome" position welder. One torch is set horizontally and performs the cut-off operations: the other is set at an angle for beveling. Jigs are made up in various sizes to accommodate different pipe diameter ells. Esso personnel can salvage one ell in about 20 minutes with the system.

In the case of the jig for salvaging flanges, two support plates provide

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TURNTABLE CAN BE ROTATED in various positions and at varying speeds

for handling flanges from 3 to 16 in. in both 150 and 300 lb. types. The jig is simply a circular plate, perforated with a series of bolt holes to permit fastening the flange down. The plate in turn has four short legs for clamping to the turntable.

Keep Small Diameter Tube Free of Catalyst Plugging

HOW CAN you keep catalyst from plugging up in small size, stainless steel tubing (⅛-in. I.D.) such as is used in a pilot plant catalytic cracking unit?

This question from a regular reader of your Plant Practices section, and published in the December PETROLEUM PROCESSING, has brought forth a welcome reply from another interested reader who has asked that his name be withheld from publication:

"In order to keep catalyst from plugging small stainless steel tubing used in connection with equipment in catalyst service, the following system can be used: a small amount of bleed air or gas flowing in the connection will prevent the backflow of catalyst.

"The bleed medium can be either air or gas, depending upon availability and vessel service. The flow should be regulated so that it is in the readings—pressure, differential, etc. The pressure at the bleed medium should be 15 to 25 psig. above the pressure in the vessel to which the tubing is connected. Bleed gas flow can be regulated by means of an orifice arrangement. The orifice, of the proper size depending upon gas supply pressure, is drilled through the plug

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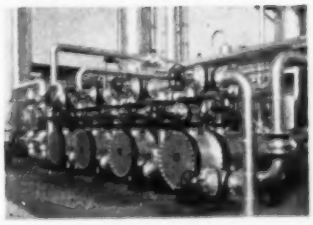

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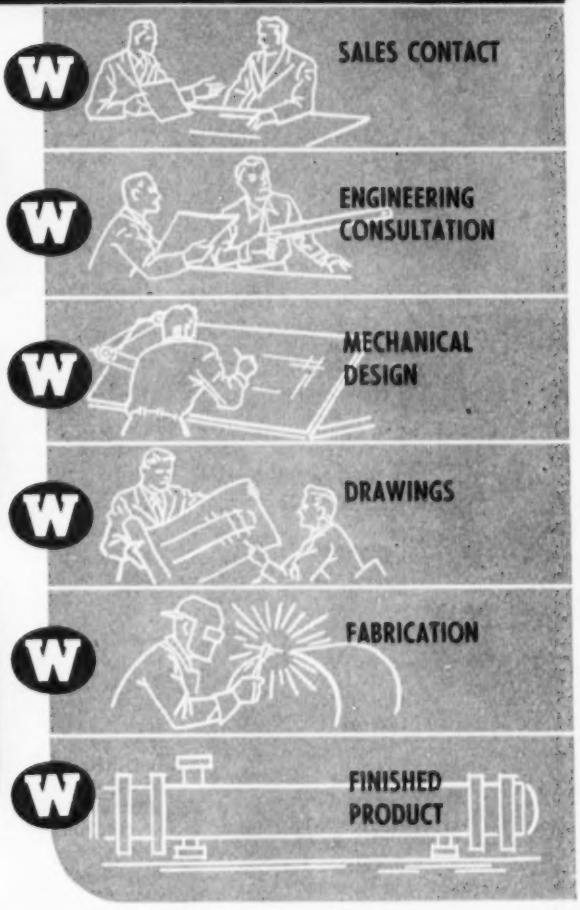

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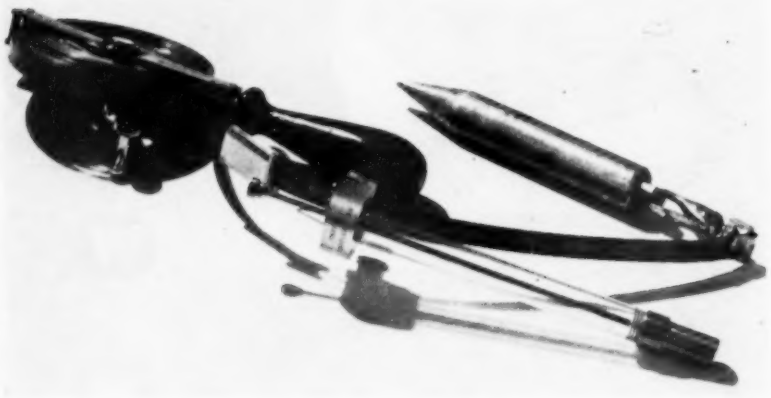
(To obtain more data on advertised products see page 424)

of a needle or meter valve or through the gate in a gate valve.

"By having the orifice in a valve, it is possible to blast the connection if necessary by merely opening the valve up wide. Where such connections are used for instruments, additional valving can be installed to isolate the instrument circuit during the blasting operation."



Accurate All-Weather Tank Gage

TANK gaging in bad weather and at night is not only unpleasant but it is also hazardous and frequently inaccurate. A device which overcomes these problems has been developed at and adopted by Union Oil Co. of California, for use in both the manufacturing and marketing departments.

Illustrated in the accompanying photograph, it is a plastic tube with a rod-controlled valve at the bottom. It is clamped to a standard steel gaging tape at the approximate depth of the liquid in the tank. The valve rod is pulled up to open the valve at the bottom of the plastic tube. The tape is then lowered into the tank until the plumb bob hits bottom. It is held in that position long enough for the liquid to enter and reach its level in the tube. This takes about 30 seconds.

A sliding tripper weight is then slipped over the tape and allowed to slide down and strike the spring trip, which lets the rod down and closes the valve, locking the liquid inside the tube. When the tape is pulled out of the tank, the gager can make his reading through the plastic tube.

Measurement of liquid levels inside storage tanks with standard gage tapes has had its difficulities, especially at night, in rough weather, or when measuring gasoline and other volatile fluids. Thus far, the Union Oil device has overcome these difficulties, the company reports, and more accurate gages are being taken.

The instrument is called the "Anderson liquid gage recorder." It was invented by Leonard Anderson, Union Oil tank calibration engineer. While an instantaneous gage is essential for absolute accuracy when a tape is used alone, to avoid the recording of a false level due to movement of the liquid surface; the necessary wait with the new liquid gage indicator is not regarded objectionable because the tube fills from below the surface.

It is acknowledged that in many cases, a quick accurate gasoline gage can be obtained by using only a gage tape. However, gagers claim this new device is indispensable under adverse conditions. Before adopting the device, Union tested it extensively for two years and concluded that the results were "uniformly excellent."

What's Your Headache?

There's a man out in an Illinois refinery who would like to have some good, helpful tips on the best ways to get asphalt through piping in cold weather. There are probably several good ways, but he'd like to have the best. Any ideas?

Send them in. If they look good, we'll print them. Or maybe you have a headache of your own. Send us that. We'll print it too; and maybe someone else will have an answer for you. Don't worry about how your answer looks. We can dress it up. Send pictures or drawings, too, if you can. Send your contributions to:

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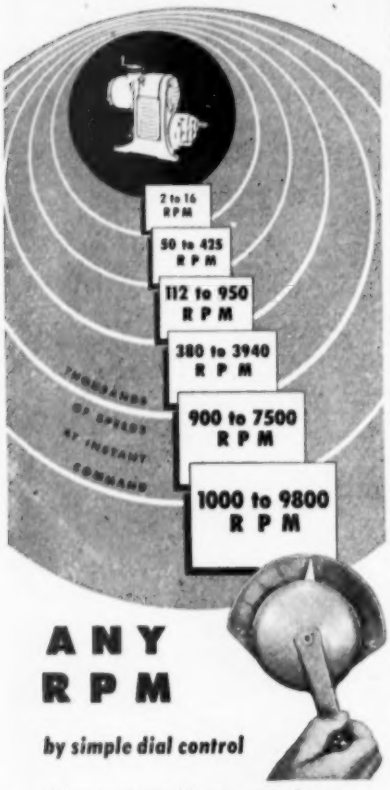

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(To obtain more data on advertised products see page 424)

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DEPENDABLE VALVES
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- Single Pan—No Weight handling
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The Sartorious "Selecta"
ANALYTICAL SPEED BALANCE

Unequaled in its range for Speed • Accuracy • Convenience • Reliability

SPECIFICATIONS

Capacity: 200 grams
Reading: 1/10 mg
Sensitivity: 1/10 mg
Automatic Range: 100 mg
Knife Edges and Planes: Agate. All Models
Damping: Fast Air Damping
Release:* Combination beam, pan support and light switch
Pan: 75 mm diameter, heavily nickel plated
Suspension: Compensating, eliminates errors due to improper placing of load on pan.
Arrestment: Sartorius Circular Type, no slipping of knife edges on bearing
Case: Sturdy light metal alloy, non-magnetic, light grey finish
Zero Point: Adjusted externally by moving indicator line or vernier
Weights: Stainless steel, adjusted to sensitivity of balance
Current: 110/220 volt built-in transformer 50/60 cycles, A.C. *only*.
(*) Release levers are provided on both the left- and right-hand side of base.

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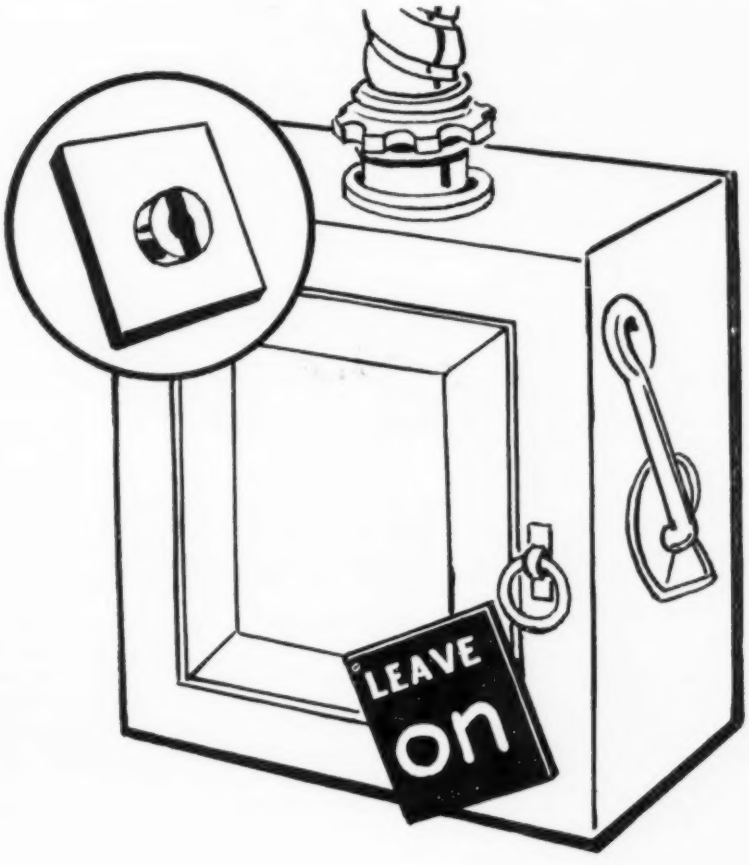

Novel Warning Tags Score a Hit

By ROBERT R. PROCTOR*

IN THE Crystal Lake, Ill., research and development laboratories of Pure Oil Co. some departments—for example, pilot plant units—operate 24 hrs./day. Others may run 16 hrs. and still others only eight hrs. and on day shift only. During the evening and the "graveyard" shifts watchmen make regular rounds of inspection of buildings, grounds, and equipment.

Because of the danger of leaving certain types of equipment in operation but unattended, one of the instructions issued to the watchmen is to turn off all electrical units such as hot plates, stirrers, pumps, hood exhaust blowers, ovens, furnaces, etc., which may have been left on accidentally when the laboratory employes left the shop at the end of their shift.

Occasionally, however, an instrument, blower, oven, or other piece of equipment must be and is left on purposely. And sometimes, in spite of hand-written notes, verbal instructions, and/or other means of notification, watchmen would too frequently turn off or unplug such units. This could spoil a run, upset some process, or allow fumes from the hoods to fill the laboratory instead of being continuously exhausted as intended.

A very simple idea was finally developed which has put an end to the confusion. Several hundred small cardboard signs, or tags, about 1½ in. square, were printed up in fluorescent red ink on a black background with the words "LEAVE ON".

On equipment which is to be left on permanently such as ventilating blowers, refrigerators, condensate pumps, etc., one of these tags is cemented on the motor controller or near the switch or plug on each piece of apparatus, using Minnesota Mining & Mfg. Co.'s cement No. EC-511.

For equipment which may or should sometimes be left on, tiny permanent magnets have been cemented to the backs of the "LEAVE ON" tags, using the same adhesive. The magnets finally selected after several tries are 2-pole Alnico V-slotted permanent magnets about ⅛ in. in diameter, Indiana Steel Products Pattern No. P-904, costing but a few cents each.

Each laboratory or department is furnished a small supply of these magnetic tags which can be quickly snapped onto any steel switch box, push-button box, steel panel, or steel screw-head in non-metallic panels. The tags are plainly visible to the watchmen even in subdued light, due to the fluorescent paint. They will remain in place in spite of drafts, severe vibration, or other disturbances.

This little tag has eliminated a big problem for the watchmen. While they still turn off all running equipment which does not bear the special tag, they now leave "ON" all equipment which should be left on as indicated by the tags. If they turn off an untagged unit which was intended to be left on, they are performing their duty as they should, and only the operator of the unit is to blame for not putting a tag on the equipment.

The convenience of the tags is further emphasized by the fact that when not in use they can be hung magnetically on the bottom of the switch boxes or on the back or top sides of pipes and conduits where they are out of sight or not visible to the watchmen and yet immediately on hand for the operator.

IDEAS—Needed!

Chemists, technicians, inspectors—send in your own contributions on "how we do it in our lab." Possible subjects might include gadgetry, shortcut procedures, safety kinks, and the like.

Please include sketches, charts, diagrams, or photographs where possible. Don't worry about the actual writing. We can dress it up if necessary. Send your ideas to:

Laboratory Practices Editor
PETROLEUM PROCESSING
1213 West Third St.
Cleveland 13, Ohio

*Mr. Proctor is assistant plant engineer, Pure Oil Co., Research and Development Laboratories, Crystal Lake, Ill.

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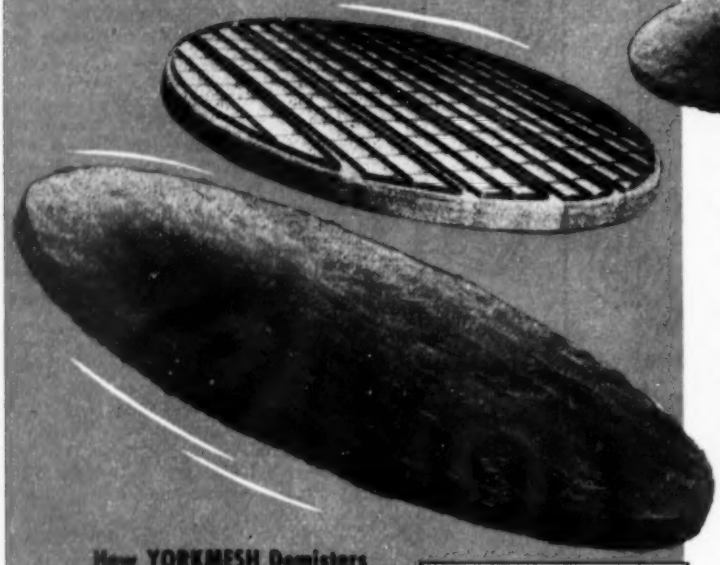


YORKMESH Demisters are answering Petroleum Engineers demands the world over for simple means of improving the performance and increasing the throughput capacities of catalytic cracking units.

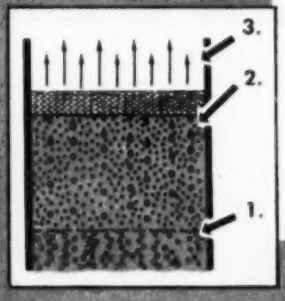
Yorkmesh Demisters in Vacuum Towers remove substantially all liquid entrainment even at increased vapor velocities—the gas oil then produced has lower carbon content and considerably reduced metals content—the reduced metals content accounts for continued high catalyst activity. The net result is more gasoline of higher octane rating.

Yorkmesh Demisters are used equally successfully to improve the performance of gas absorbers, scrubbers, separators, evaporators, knock-out drums, etc.

Easily installed in existing or new equipment.—Materials: Types 430, 304, 316 stainless, monel, carbon steel, etc.—Prompt shipment.

How YORKMESH Demisters work inside Vacuum Towers

1. *Vapor disengaging from liquid creates fine liquid droplets which are carried as entrainment by the vapor stream.*
2. *The liquid droplets impinge on the fine wire surfaces of YORKMESH, and are coalesced into large drops which run down and fall off the YORKMESH.*
3. *The vapor is now dry. It has been entirely freed from entrained liquid. Thus a clean gas-off goes to the catalytic crusher.*

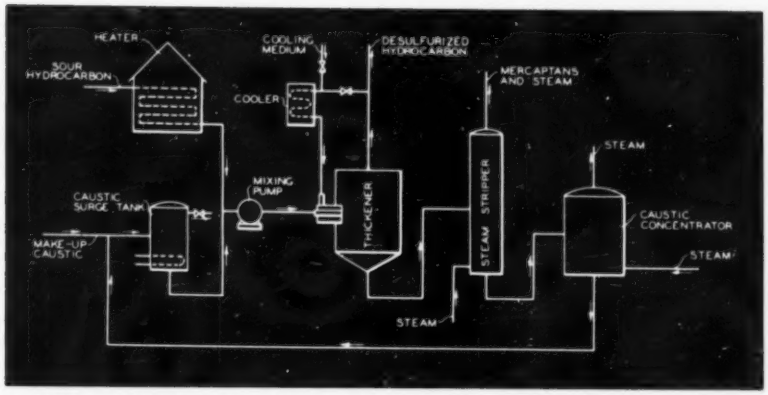


Write for new Catalog 13 full complete information and engineering data on YORKMESH Demisters.

OTTO H. YORK Co., INC.

67 Glenwood Place, East Orange, N. J.

By Peter J. Gaylor, *Patent Attorney, Gaylor, Cifelli & Jurick, Newark, N. J.*



CONCENTRATED CAUSTIC is used in this process which Phillips Petroleum has developed for scrubbing mercaptans out of sour naphthas (U. S. 2,623,008)

Sweetening with 56-80% Caustic Soda Gives Better Separation, Less Loss

IT HAS been common practice to scrub mercaptans out of sour naphthas with relatively dilute caustic soda of up to 30% concentration. Now, a Phillips Petroleum Co. patent (2,623,008) advocates the use of much stronger caustic, 56% to 80%, and preferably 60-75% by weight. Since aqueous solutions of the latter concentrations have freezing points in the range of 120°-142° F., it is necessary to preheat the hydrocarbon to be treated to 100°-300° F.

One apparent advantage of the process is that the mercaptides separate from the hydrocarbons in the form of a precipitate. Another advantage claimed is that caustic loss due to emulsification is reduced because the strong caustic salts out any soaps which may be formed.

As can be seen from the flowsheet above, the preheated sour gasoline and caustic solution are mixed in the pump and discharged through a heat exchanger or mixer into which unheated hydrocarbon is fed as a cooling means. The cooled mixture then is discharged into a Dorr thickener, from the top of which the desulfurized hydrocarbon is removed. A slurry of caustic and mercaptides is drawn off the bottom of the thickener and recovered with steam or by any other suitable means.

Cadmium Sulfate Solution Removes Hydrogen Sulfide

THE use of an aqueous sulfuric acid solution of cadmium sulfate is proposed in the Phillips Petroleum Co. patent 2,624,694 as an extraction means for removing hydrogen sulfide from fluids. A satisfactory acid solution is one having a concentration of 25-75% (preferably 40-60%) by weight of sulfuric acid. The cadmium sulfate concentration is preferably below saturation at ordinary temperatures to prevent precipitation and loss of cadmium salt.

In the scrubbing operation at 0°-150° F., cadmium sulfide is produced, and this is regenerated in a separate step by heating to 200°-300° F., which expels the hydrogen sulfide. After regeneration, the solution is cooled to about 75° F., and recycled to the absorption tower.

Promoted Carbon Catalyst For Reforming Naphthas

PROMOTED high area-activated carbon catalysts are claimed to give a high recovery of reformed liquid products. U. S. patent 2,592,603, issued to Sinclair Refining Co., points out that, unlike clays, carbon catalysts are not good heat carriers, so that there is a definite problem of maintaining the reaction temperature in view of the endothermic nature of cracking reactions, without employing a series of reactors with intermediate reheating, or using special and costly reaction tubes.

The naphtha reforming operation is conducted in presence of a carbon catalyst which has been specially modified by incorporation of an alkaline compound or salt of an alkali metal as a promoter. The activity of the catalyst is maintained due to the water gas activity of such promoter. Regeneration is effected by exposure to steam at high temperature (about 1300° F.).

Although a number of alkaline salts are useful as promoters, the particularly valuable ones are the sodium compounds, such as the silicate, phosphate, hydroxide and carbonate. Lithium hydroxide also may be used, as well as potassium phosphate which gives a comparable performance. Potassium carbonate is inferior to the phosphate. In the case of the potassium salts, those compounds are favored which are stable against hydrolysis or decomposition to the free oxide or the free metal at reaction conditions. The carbon catalyst should contain 1-10% of such promoter.

Contrary to most catalytic reforming processes, the use of steam as a diluent is more desirable (in terms of product distribution and yield-octane relation) than hydrogen.

Convert Alkyl Disulfides Into Sulfonyl Chlorides

IN the removal of mercaptans from gasoline by caustic soda extraction, considerable amounts of alkyl disulfides are obtained. In its Patent 2,598,014, Standard Oil Co. (Ind.) describes a method for converting these disulfides into highly reactive sulfonyl chlorides.

The process involves treatment of the disulfides with chlorine and oxygen in accordance with the following equation:

$$RSSR + Cl_2 + 2O_2 = 2RSO_2Cl$$

It is apparent from the above equation, that 100% theoretical efficiency of chlorine utilization is possible, whereas prior art processes utilized a maximum of only 20 mol % of the chlorine.

The process is conducted at −20° C. to 50° C., preferably at 5°-15° C., in presence of nitrogen dioxide as a catalyst (0.05-0.2% by weight of the oxygen charged), in diffused daylight. Actual yields of 40-80% are obtained. Non-tertiary hydrocarbon disulfides must be employed.

Minimize H_2O Introduction In Sweetening Gases

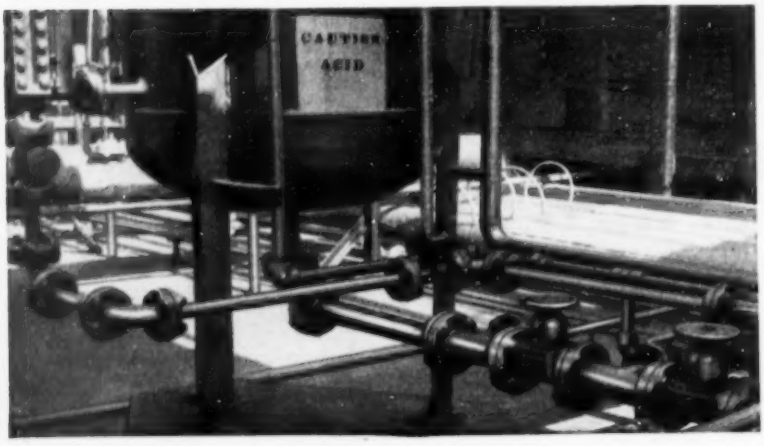
IN REMOVING mercaptans from gaseous hydrocarbons, it is often desirable to minimize the introduction of water in order to avoid hydrate formation problems.

U. S. Patent 2,598,034, issued to Universal Oil Products Co., describes a process whereby the gas is first scrubbed with a liquid hydrocarbon solvent such as a pentane fraction

DOW

CORROSIVE FERRIC CHLORIDE FLOWS THROUGH THIS SARAN LINED INSTALLATION

Large West Coast refinery depends on easy-to-install SARAN LINED STEEL PIPE to resist corrosion and assure uninterrupted processing



Some time ago, a large West Coast oil company investigated better methods to handle corrosive ferric chloride solution. The company's successful operation demands uninterrupted processing. Unscheduled "shut-downs" mean production pile-ups, lay-offs and heavy expense. Saran Lined Steel Pipe was successful from the start. The use of Saran Lined Pipe Fittings and Valves assured tight, leak-proof joints. The dependable, long-term service and excellent corrosion resistance of strong, rigid Saran Lined Pipe will postpone replacements indefinitely. Saran Lined Steel Pipe can be delivered immediately, cut and threaded to your specifications or fabricated in the field with your own equipment. We'll be glad to assist you with installation plans. Write or call the SARAN LINED PIPE COMPANY, Ferndale, Michigan. Offices in New York • Boston • Pittsburgh • Tulsa Philadelphia • Chicago • Portland Indianapolis • San Francisco • Houston Denver • Los Angeles • Seattle Cleveland • Charleston, S. C. Toronto • Montreal.

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or benzine, xylene, etc. The solvent containing mercaptans then is treated with copper chloride which converts the mercaptans to disulfides, and the disulfide-containing hydrocarbon is further used as a solvent for extracting mercaptans. The gas preferably is subjected to a hydrogen sulfide removal step, employing a dilute caustic or similar extractant.

Sweetening Sour Distillates

ONE method recently disclosed for oxidizing mercaptans in kerosene, for example, consists in adding up to 1% by volume of naphthenic acid and up to 5% caustic, and then blowing with oxygen at 70°-95° F. until a substantial portion of the mercaptans is converted to disulfides.

One example given in Standard Oil Development Co. patent 2,569,370, describes the addition to a hydrogen sulfide-free kerosene of 1% by volume of 40° Bé caustic in one case, and an additional 0.1% by volume of naphthenic acids to the foregoing in another case. Both samples were blown with oxygen. In the first case the copper number (after settling) was reduced from 55 to 49 after 20 hours blowing, while in the second case (to which naphthenic acids were added) the copper number was reduced from 47 to 17 in the same period.

Patents Issued in January

The following classified listing gives the patent number, patentee, or assignee, and a brief description of all patents believed to be of interest to the petroleum processing industries, as contained in the Official Gazette of the U. S. Patent Office for Jan. 6, 13, 20, and 27, 1953, Vol. 666, Nos. 1-4.

PROCESSES

Catalysts

2,624,172 (Eugene J. Houdry) Process of generating power involving catalytic oxidation.
2,626,245 (Aristid V. Grosse) Suppressing the oxidation of CO to CO_2 in a fixed bed regenerator.

Conversions

2,624,696 (Lummus Co.) Continuous carbonization of coal and oil mixtures.
2,624,697 (Sinclair Refining Co.) Coking in a fluidized state.
2,624,713 (Monsanto Chemical Co.) Iron fluoride-manganese fluoride aromatizing catalyst.
2,625,442 (Houdry Process Corp.) Apparatus for elevating granular material.
2,625,467 (Houdry Process Corp.) Apparatus for flowing gases through beds of fluent granular solids.
2,625,504 (Universal Oil Products Co.) Catalytic reforming process and alumina-boron oxide-Pt catalyst.
2,626,204 (Universal Oil Products Co.) Apparatus for conducting catalytic endothermic and exothermic reactions.

(To obtain more data on advertised products see page 424)

2,626,205 (Sinclair Refining Co.) Gravity bed reactor.
2,626,233 (Standard Oil Development Co.) Catalytic cracking of hydrocarbons in the presence of added gaseous olefins.
2,626,235 (Socony-Vacuum Oil Co.) Method and apparatus for solid transfer.
2,626,247 (Standard Oil Co.-Ind.) Fluidized solids flow control system.
2,626,286 (Standard Oil Development Co.) Production of aromatics and saturated aliphatics by dehydrogenation.
2,626,288 (Phillips Petroleum Co.) Method for bringing a newly charged catalytic reactor on stream.
2,626,289 (Standard Oil Development Co.) Process for polymerization in the presence of a fluid solid polymerization catalyst.
2,626,290-1 (Standard Oil Development Co.) Process for polymerizing olefins with a phosphoric acid slurry catalyst.
2,626,292 (Standard Oil Development Co.) Removal of finely divided solids from polymerization streams.
2,626,293 (Standard Oil Development Co.) Slurry polymerization process.
2,626,857 (Socony-Vacuum Oil Co.) Apparatus for hydrocarbon conversion.
2,626,892 (Standard Oil Development Co.) Cracking residual fractions containing salts.
2,626,966 (Sun Oil Co.) Alkylation of aromatic hydrocarbons.

Hydrocarbon Synthesis

2,625,465 (Sinclair Refining Co.) Continuous carbon monoxide generation.
2,625,470 (Stanolind Oil & Gas Co.) Method for producing (CO-H_2) reducing gas mixtures.
2,626,246 (The Texas Co.) Regenerating cobalt catalysts by oxidation.
2,626,274 (Stanolind Oil and Gas Co.) Hydrocarbon synthesis.
2,626,275 (Hydrocarbon Research) Process for catalytic conversion of carbon monoxide and hydrogen to hydrocarbons, oxygenated hydrocarbons, and the like.
2,626,276 (Standard Oil Development Co.) Recovery of organic oxygen-containing compounds from mixtures of hydrocarbon oils.

Refining

2,624,694 (Phillips Petroleum Co.) Removal of hydrogen sulfide with cadmium sulfate solution.
2,625,236 (Belco Industrial Equipment Division, Inc.) Apparatus for separating gases from liquid.
2,625,240 (Thermix Corp.) Apparatus for separating suspended particles from gases.
2,625,377 (Phillips Petroleum Co.) Pebble chamber.
2,625,502 (Union Oil Co.) Wax-oil separation using aromatic solvent.
2,625,503 (Sinclair Refining Co.) Copper chloride refining of light oil distillates with disulfide removal as bottoms.
2,625,917 (Universal Oil Products Co.) Fluid heating apparatus.
2,625,918 (Thomas M. Lumly) Fluid heating apparatus.
2,626,006 (Ingersoll-Rand Co.) Liquid-gas separator.
2,626,141 (Babcock & Wilcox Co.) Fluid heating apparatus.
2,626,208 (Standard Oil Co.-Ind.) Preparation of stable distillate fuels from cracked stocks by caustic treating and adding polybutene phosphorus sulfide reaction product.
2,626,229 (Carl F. Miller and Albert Miller) Apparatus for refining used lubricating oil.
2,626,230-1 (Atlantic Refining Co.) Solvent fractionation of wax-containing mixtures.
2,626,232 (Standard Oil Development Co.) Method for sweetening hydrocarbons with hypochlorite.
2,626,234 (Standard Oil Development Co.) Heat exchange of fluidized solids with gases and vapors.
2,626,287 (Phillips Petroleum Co.) Pebble heater apparatus and method of operation.
2,626,679 (Koppers Co.) Diffusion process.
2,626,889 (Phillips Petroleum Co.) Method of an apparatus for liquid-liquid contacting.
2,626,890 (Pure Oil Co.) Sweetening gasoline by oxidizing mercaptans in presence of sulfonated compound.
2,626,891 (Standard Oil Development Co.) Gasoline treating process, using lead tetraacetate.
2,626,894 (Standard Oil Development Co.) Method and apparatus for preventing coke formation in distillation towers.
2,626,901-29 (Petrolite Corp.) Process for breaking petroleum emulsions.
2,626,959 (Universal Oil Products Co.) Process for extraction of olefinic hydrocarbon mixtures with nitrile.

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Now science replaces "sensitive feel" in tube rolling! The AIRETOOL Tube Expansion Control System eliminates danger of over or under expansion. It automatically regulates the amount of expansion, produces maximum tightness and holding strength in every tube joint! With this system you can actually cut tube rolling time in half! Easy to use. Set dial for tube size, insert ball bearing expander and start powerful motor. When the tube joint reaches proper expansion and tightness, the control automatically shuts off the power. For more information and a convincing demonstration, write to:

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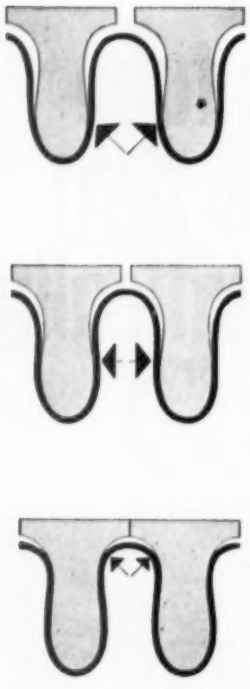

directed flexing is the better buy!

Granted this is a rather abrupt and sure statement, yet we believe you will agree with it once you fully understand what Directed Flexing is and how it smooths out joint action, produces the ideal flexing movement, protects against over concentrated stresses . . . all of which make for long joint life.

Two design features are linked with the Directed Flexing feature. In fact, they are responsible for it.

1 the all-curve corrugation

2 the matching shape of the equalizing rings

Note how the corrugation when flexing under the force of the line movement uses the side surfaces of the adjacent rings as a guide. Instead of moving more or less as a flat plane, as would a straight sided corrugation, it actually wraps itself around the ring, contacting it progressively from bottom to near the top, reversing itself when the line cools off. This action not only distributes flexing stresses. It smooths out the movement. The equalizing rings, essential to this action, serve in another important way. They progressively control and limit the traverse on all corrugations.

This, in a nut shell, is the engineering back of the Badger Directed Flexing feature. If you will give a moment's thought to the stresses set up in a joint by a pipe line movement, you, too, will give full wieght to the value of the Directed Flexing design of these expansion joints. You, like countless others, will see that Badger Expansion Joints will go onto your lines.

BADGER MANUFACTURING COMPANY

Original and Sole Manufacturer of Badger Expansion Joints

230 BENT STREET • CAMBRIDGE • MASS.

Patents

2,626,967 (California Research Corp.) Deodorization of monoaryl substituted alkanes with silica-alumina adsorbent.

PRODUCTS

Chemicals

2,624,717 (Universal Oil Products Co.) Production of copolymer oils having drying properties.

2,624,726 (Standard Oil Development Co.) Copolymerization of diolefins and aromatics.

2,624,742 (Universal Oil Products Co.) Alkyl thiophene sulfonate detergents.

2,624,752 (Shell Development Co.) Esters of tertiary alkyl-substituted aromatic acids.

2,625,521 (Standard Oil Development Co.) Stabilized plastic compositions of chlorine-containing vinyl resins.

2,625,523 (Standard Oil Development Co.) Butadiene polymer composition and process of preparing same.

2,625,525 (Phillips Petroleum Co.) Terpolymers of sulfur dioxide monoolefinic materials and a liquid polymer of a conjugated diene, and their production.

2,625,526 (Standard Oil Development Co.) Polyvinylchloride-dienenitrile-polyester composition.

2,625,527 (Standard Oil Development Co.) Alkylesters and plastic compositions comprising same.

2,625,528 (Phillips Petroleum Co.) Processing of sulfur-vulcanizable materials, and related compositions.

2,625,534 (Universal Oil Products Co.) Resins and process for producing same from reaction products of hydroxy aromatic aldehydes and mercaptans.

2,625,538 (Standard Oil Development Co.) Controlled polymerization process.

2,625,557 (Standard Oil Development Co.) Purification of acyl p-aminophenols with isopropyl alcohol.

2,625,560 (Stanolind Oil and Gas Co.) Separation of oxygenated compounds with bisulfite adducts.

2,625,568 (Standard Oil Development Co.) Ketone condensation products of bisphenyl type compounds.

2,625,570 (Universal Oil Products Co.) Conversion of polyhydric phenols and ethers of polyhydric phenols.

2,625,571 (Universal Oil Products Co.) Di-(alkylphenyl)-alkenes.

2,626,247 (Cities Service Research and Development Co.) Oxidation of petroleum fractions (paraffin wax).

2,626,279 (Phillips Petroleum Co.) Thiolesters and their preparation.

2,626,282 (Standard Oil Development Co.) Vapor phase production of beta-methylmercaptopropionaldehyde.

2,626,283 (Shell Development Co.) Preparation of acrolein acetal.

2,626,284 (Standard Oil Development Co.) Aqueous caustic treat of iso-octyl alcohol.

2,626,940 (Standard Oil Development Co.) Olefin - cyclodiene - divinylbenzene tripolymer and preparation thereof.

2,626,945 (United States Rubber Co.) Interpolymerization of polyolefinic esters of 2-alkenyl alcohols with certain monoolefinic hydrocarbons.

2,626,962 (Universal Oil Products Co.) Production of haloolefinic compounds.

Fuels

2,626,207 (Shell Development Co.) Fuel oil composition containing sulfonate sludge inhibitor.

2,626,209 (Standard Oil Development Co.) Production of ketone compounds for fuel mixtures.

2,626,893 (Standard Oil Development Co.) Aromatic aviation fuel blending agent and method for producing same.

Lubricants

2,624,707 (Shell Development Co.) Lubricating composition containing P-S product of thiophene, etc. for E.P. purposes.

2,624,708 (Union Carbide and Carbon Corp.) Inhibited polyoxyalkylene glycol fluids.

2,625,508 (Shell Development Co.) Inorganic gel water resistant grease.

2,625,509 (Socony-Vacuum Oil Co.) Cutting fluid and coolant.

2,625,510 (Shell Development Co.) Lubricating grease composition containing oxidized aromatic extract.

2,625,511 (Gulf Research & Development Co.) Thioamide anticorrosion agents and compositions comprising the same.

2,626,240 (The Texas Co.) Noncorrosive soluble oil containing active sulfur and alkylene diamine.

Patents

2,626,241 (Standard Oil Development Co.) Bentonite greases.
2,626,896 (The Texas Co.) Process for preparing alkali metal greases.
2,626,897 (Sun Chemical Corp.) Aluminum soaps.
2,626,898 (The Texas Co.) Process for preparing alkali metal greases.
2,626,899 (Shell Development Co.) Grease compositions containing cation exchange colloid.

Specialties

2,624,591 (Sun Oil Co.) Container having paraffin wax product coating.
2,624,693 (Sun Oil Co.) Wax product and process of preparing same.
2,625,466 (J. M. Huber Corp.) Process and apparatus for making carbon black.
2,625,489 (The Texas Co.) Weather-resistant concrete containing paraffin wax emulsion.
2,625,491 (Standard Oil Development Co.) Stabilized wax composition containing t-butyl-methyl phenol, etc.
2,625,518 (California Research Corp.) Odorant for gaseous fuels from acid sludge.
2,626,870 (Standard Oil Development Co.) Wax and silicone oil auto polish.
2,626,872 (Great Lakes Carbon Corp.) Asphalt building board.
2,626,875 (Kenneth E. McConnaughay) Process of preparing a paving composition.

Miscellaneous

2,624,198 (Sun Oil Co.) Flowmeter.
2,625,034 (Armstrong Cork Co.) Rheometer.
2,625,540 (Phillips Petroleum Co.) Wood rosin refining process.
2,626,459 (Standard Oil Development Co.) Method of welding stainless steel.

EQUIPMENT

Processing, general

2,624,461 (American Cyanamid Co.)—Float removal device for rotatable pipe heavy media separator.
2,624,465 (A. C. Kracklauer)—Horizontal plate filter.
2,624,556 (The Norton Co.)—Heat exchange pebble.
2,624,704 (The Dorr Co.)—Sewage treatment unit.
2,625,238 (Koppers Co., Inc.)—Electrical precipitator.
2,625,320 (Bird Machine Co.)—Centrifuge for rapid extraction of fine particles from suspension.
2,625,321 (Merco Centrifugal Co.)—Continuous centrifuge of the type with an underflow return circuit.
2,625,377 (Phillips Petroleum Co.)—Pebble heat exchange chamber.
2,625,383 (The Fluor Corp.)—Gas scrubber.
2,625,466 (J. M. Huber Corp.)—Carbon black furnace and process.
2,625,791 (The Bituminous Coal Research, Inc.)—Coal pulverization and combustion apparatus for gas turbine power plants.
2,625,915 (National Tank Co.)—Internal heat exchanger for process vessels.
2,625,916 (Universal Oil Products Co.)—Modified up-draft type of process heater.
2,625,917 (Universal Oil Products Co.)—Vertical cylindrical process heater.
2,625,918 (Thomas M. Lumly)—Vertical fluid process heater.
2,626,006 (Ingersoll-Rand Co.)—Liquid gas separator.
2,626,129 (The Industrial Manufacturer, Ltd.)—Liquid distributor for cooling tower apparatus.
2,626,229 (Carl F. and Albert Miller)—Unit for refining used lubricating oil.
2,626,287 (Phillips Petroleum Co.)—Pebble heater unit and method of operation.
2,626,675 (National Tank Co.)—Sorbing tower.
2,626,676 (Research Corporation)—Electrical precipitator.
2,626,709 (Selas Corp. of America)—Liquid separator for immiscible liquids.
2,626,745 (E. K. and M. E. Haferkamp and V. H. Fletcher)—Centrifuge unit.
2,626,746 (Samuel L. Abbott)—Centrifuge.
2,626,747 (Emil L. Ranseen)—Centrifugal separator.
2,626,889 (Phillips Petroleum Co.)—Apparatus and method for liquid-liquid contacting.
2,626,894 (Standard Oil Development Co.)—Apparatus and method for preventing coke formation in distillation towers.

Catalytic Reactors

2,625,467 (The Houdry Process Corp.)—Chamber for contacting flowing gases with beds of fluent granular solids.

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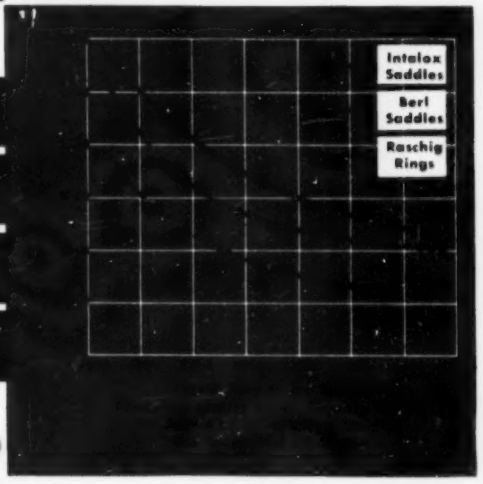

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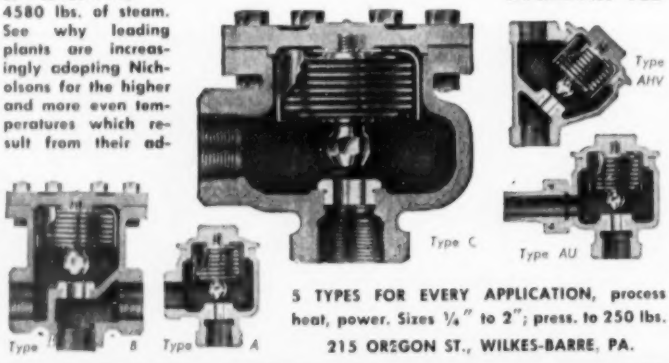

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Patents

2,626,204 (Universal Oil Products Co.)—Unit for conducting catalytic endothermic and exothermic reactions.
2,626,205 (Sinclair Refining Co.)—Gravity bed catalytic reactor.
2,626,247 (Standard Oil Co. (Ind.))—Fluidized solids flow control system for catalytic reaction unit.
2,626,857 (Socony-Vacuum Oil Co., Inc.)—Moving bed type of catalytic unit for hydrocarbon conversion.

Instruments

2,624,198 (Sun Oil Co.)—Flowmeter based on gyroscope principle.
2,624,199 (M. H. Boyer)—Fluid flowmeter based on thermoelectric principle.
2,624,308 (Albert Wittlin)—Liquid flow indicator.
2,624,398 (Combustion Control Corp.)—Photocell controlled safety system for fuel burners.
2,624,507 (International Business Machines Co.)—Electronic calculator.
2,624,508 (International Business Machines Co.)—Electronic dividing and multiplying apparatus.
2,624,701 (Consolidated Engineering Corp.)—Electrolytic titration cell.
2,624,770 (Sun Oil Co.)—Vacuum tube voltmeter.
2,624,782 (Anglo-Iranian Oil Co., Ltd., London, England)—Apparatus and method for detecting water in oil.
2,625,042 (Magnetrol, Inc.)—Liquid level responsive mechanism.
2,625,043 (Gilbert & Barker Mfg. Co.)—Apparatus for measuring the average temperature of liquids in storage tanks.
2,625,458 (Minneapolis - Honeywell Regulator Co.)—Electrical recorder.
2,625,459 (Pennsylvania Research Corp.)—Recording apparatus.
2,625,584 (Edward L. Kells and Delmar H. Larsen)—Magnetic oxygen detector.
2,625,586 (The Bell Telephone Laboratories, Inc.)—Electronic apparatus for measuring gas pressures.
2,625,588 (Melville F. Peters)—Apparatus for mea uring potential differences in liquids.
2,625,641 (Audrey L. Jenkins)—Gravity sample heater.
2,625,820 (Minneapolis - Honeywell Regulator Co.)—Liquid level gauge.
2,625,822 (Taylor Instrument Co.)—Self-balancing potentiometer system.
2,625,911 (Minneapolis - Honeywell Regulator Co.)—Air motor controller with self-balancing potentiometer.
2,625,914 (Bowser, Inc.)—Positive displacement flowmeter.
2,626,103 (Radio Corporation of America)—Polynomial equation solver.
2,626,361 (The Specialties Development Corp.)—Photoelectric unit for detecting suspended matter in fluids.

Tanks and Vessels

2,624,490 (Hammond Iron Works)—Oil storage tank.
2,624,553 (General American Transportation Corp.)—Heating system for tanks.
2,625,314 (Chicago Bridge & Iron Co.)—Ladder for floating roof tanks.

Pumps and Compressors

2,624,282 (J. R. Allsup)—Rotary vane pump or motor.
2,624,287 (Borg-Warner Corp.)—Gear pump.
2,625,105 (Louis Fincher)—Self-reversing rotary pump.

Valves and Fittings

2,624,364 (Crane Co.)—Diverter valve using one inlet, two or more outlets, and a flexible liner for varying the flow from one outlet to the other.
2,624,541 (Askania Regulator Co.)—Butterfly valve.
2,624,644 (Crane Co.)—Valve actuator.
2,626,633 (Allen D. Wilson)—Pressure operated gate valve.
2,626,774 (Charles E. Palmer)—Gate valve and operating mechanism.
2,626,775 (Frank H. Temple)—Gate valve.
2,626,820 (E. M. Dons and Jesse V. Stevens)—Pipe coupling.

Miscellaneous

2,625,414 (The DuPont Co.)—Sealing elements for pressure vessels.
2,626,974 (The Pyle-National Co.)—Explosion-proof electrical plugs and sockets.
2,626,975 (The Pyle-National Co.)—Delayed-action structure for an explosion-proof electrical plug and socket.

CHEMICAL PROCESS NEWS

PUBLISHED BY CHEMICAL PROCESS DIVISION, THE M. W. KELLOGG COMPANY MARCH 1953

NOTES ON Ethylene

The world's first naphtha pyrolysis and purification plant for the production of high purity ethylene has now been on stream in England for well over a year. A second is under construction in Italy.

* * *

Both were designed by Kellogg. The one in England has consistently produced high yields of ethylene with a purity of 99.9%. Loss during low temperature fractionation is less than 3%.

* * *

Of particular interest is the fact that the C-3 product made as a bottoms stream from the deethanizer contains 93–97% propylene . . . indicating the high selectivity of the cracking process for olefin production. This by-product is suitable for chemicals production at high efficiency without fractionation between propylene and propane.

* * *

Actually the plant may be operated under different conditions to produce olefins in varying proportions. This has been well demonstrated in work done over a number of years in Kellogg's naphtha pyrolysis pilot plants. Such flexibility would be particularly important to the processor whose markets for various olefins might change in accent.

* * *

Current interest in naphtha pyrolysis as the prime step in producing high yields of olefins is largely restricted to processors abroad. Domestically, heavy gas oil will probably become important as a charge stock.

High Pressure Gas Reforming Slated for West Coast Ammonia Unit

A special high-pressure gas reforming plant will be the feature of a new ammonia plant Kellogg is currently erecting for a West Coast processor. Shown here during construction, the unit will produce well over 300,000 pounds of anhydrous ammonia daily from a natural gas feed stock.

The result of pilot plant studies by Kellogg, the reformer section of the plant makes use of the fact that natural gas is usually available at relatively high pressure. Rather than design the reformer for operation at conventional low pressure and thus produce low pressure synthesis gas, Kellogg engineered this section to conserve the potential energy of the natural gas. Although the synthesis gas must be still further compressed before it is charged to the converter, the new high pressure reformer will save about 25% to 35% on compressor horsepower.

In addition to the gas plant, the ammonia unit includes the Kellogg reactor, which is especially designed to maintain optimum conversion temperatures.

Close control of temperatures is extremely important to this process. To attain a reaction rate high enough to be economic, temperatures must closely approach the point at which catalyst activity deteriorates rapidly and at which construction materials are attacked at an appreciable rate.

Therefore, in the ideal ammonia converter, it is essential to remove excess heat as rapidly as possible from every point where exothermic reaction occurs. Since these points "move about" through changes in the conditions of operation and through aging of catalyst, the design of an economical converter that completely solves the problem of excess heat removal, when and where it is produced, has posed a difficult problem.

However, the new Kellogg converter which employs layers of catalyst with an efficient means of cooling the gases in between, closely approaches the ideal point-by-point temperature control.

In addition to the plant now going up on the West Coast, Kellogg has designed several others with conventional reformers but with the special reactors. Three large ones were built virtually simultaneously during World War II. Since they have been in operation they have continued to maintain the highest efficiency levels in the industry.

(SEE REVERSE SIDE)

CONTINUED FROM PRECEDING PAGE

New Phthalic Plants Incorporate Recent Improvements

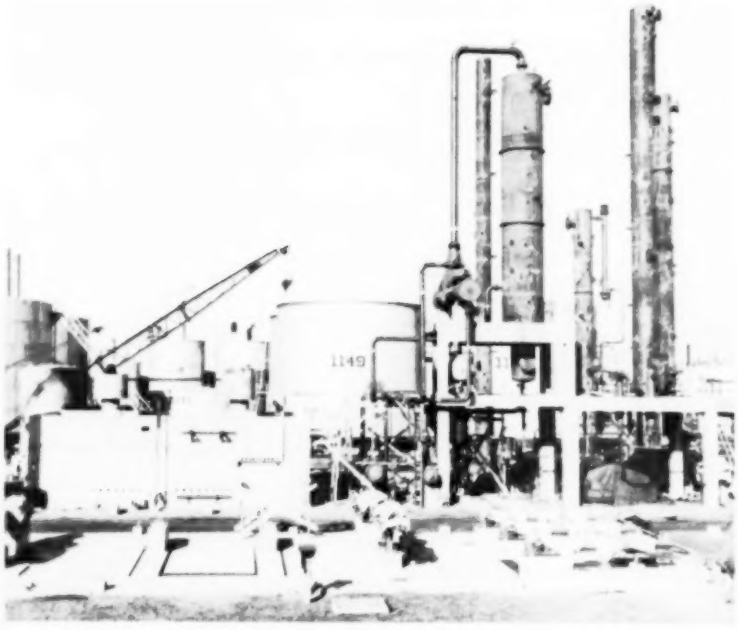
First to be built since the initial commercial plant was designed for a major U. S. processor, two new Fluid phthalic anhydride plants are now underway for two important chemicals companies in England and Italy.

Several design improvements are being incorporated in these new plants. Most important is a re-design of the condensing system which not only decreases capital investment but also improves actual operating conditions. It precludes, for example, any need for operators to come in direct contact with the phthalic or its fumes.

First Kellogg Fluid Phthalic Anhydride Plant

Between them the two plants will produce about 50 million pounds of phthalic anhydride annually. The product in this process is produced by the oxidation of naphthalene in the presence of fluidized solid catalyst.

Meanwhile, in view of the domestic irregularity of supply of naphthalene, Kellogg is continuing its study of the possibilities of using other feeds for this process. While no conclusive data is yet available, other feed stocks are currently being viewed by the industry as a whole with considerable interest: alpha-methyl-naphthalene, ortho-xylene and others. Since the first of these materials is produced as a by-product of both Fluid catalytic cracking and Hydroforming it appears to meet constant availability requirements.



New Iso-Octyl Alcohol Plant Progresses

Engineered by Kellogg, this new iso-octyl alcohol plant is scheduled for completion this year. The vessels on the concrete structure at the right are the alcohol, alcohol re-run and aldehyde towers. They comprise only a small portion of the complete unit.

Kellogg is also currently designing several different types of alcohol plants for other processors. These include units for the production of a wide range of alcohols.

- ★ Phenol-from-cumene (2)
- ★ Iso-octyl-alcohol
- ★ Ethylene
- ★ Ammonia
- ★ Phthalic Anhydride (2)
- ★ Glyceride Purification
- ★ Liquid Fuel and Chemicals Synthesis from Coal

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PERSONALS

Gordon R. Henderson is manager of Sun Oil Co.'s new refinery now under construction at Sarnia, Ontario.

Born in London, Ontario, he graduated from Queen's University, Kingston, Ontario, in civil engineering. In 1932 he joined the engineering staff of Shell Oil Co. of Canada and became chief engineer of its Montreal refinery in 1936. During World War II he supervised the building of Shell's refinery at Heysham Lanes, England. Returning to Canada in 1943, he joined Polymer Corp., Ltd. as petroleum engineer on design and construction of its synthetic rubber plant.

Mr. Henderson

Before joining Sun, Mr. Henderson was vice president and general manager of Catalytic Construction of Canada, Ltd., directing that company's Canadian activities, which include the building of Sun's Sarnia refinery.

* * *

Julian M. Avery is a technical adviser for Ethyl Corp., his work to be primarily with the company's planning group on product development and research programs, and in charge of technical contracts in foreign countries. He has been a consultant to Ethyl Corp. for the past two years, and was formerly with Union Carbide and Carbon Co., Arthur D. Little, Inc. and Diamond Alkali Co., and a vice president and director of Hodges Research and Development Co.

* * *

Howard S. Spering has been appointed assistant director of the Refining Division of PAD in Washington. He received an AB degree from Dickinson college and in 1932 an LL.B from Yale Law School. During the following 10 years he practiced law in Philadelphia. From 1942 to 1946, he acted as Counsel for the Reconstruction Finance Corp. in Washington.

Mr. Spering joined the Texaco Development Corp. in 1947 as executive assistant. In 1951 he was granted a leave of absence to serve with PAD in Washington, and has been there since.

E. E. Ebner, general supt. of refineries for Quaker State Oil Refining Corp., is new chairman of the Technical Advisory Committee of the Pennsylvania Grade Crude Oil Assn. He succeds the late **MacLean Houston.** Mr. Ebner has appointed the following subcommittee chairmen: **Dr. A. W. Lewis** (Tide Water Associated Oil Co.), Armour Research Foundation of Illinois Institute of Technology steering subcommittee; **F. I. L. Lawrence** (Kendall Refining Co.), steering subcommittee of the Petroleum Refining Laboratory, Pennsylvania State College; **C. W. Cable** (United Refining Co.), additive subcommittee.

* * *

L. C. Burroughs, assistant to manufacturing vice president, Shell Oil Co. has been appointed by the API as the representative of the oil industry on the National Technical Task Committee on Industrial Wastes, a committee of the U. S. Public Health Service. Mr. Burroughs will act as vice chairman of the committee.

* * *

Harold Bottomley is opening offices in Tulsa as a petroleum processing consultant, offering services in plant process surveys, economic studies, appraisals and evaluations, and mechanical design. He has resigned as vice president of Refinery Engineering Co. Mr. Bottomley is a graduate of Oklahoma A&M College with a degree in mechanical engineering, petroleum refining option. He has worked in the past for Shell Petroleum Corp., Arkansas City, Kans.; Kanotex Refining Co. in the same city; Cosden Petroleum Corp., Big Spring, Tex.; and Republic Oil Refining Co., Texas City, Tex.

* * *

M. E. Spaght has been elected to the board of directors of Shell Oil Co. Mr. Spaght, formerly president of Shell Development Co., research affiliate of Shell Oil, was recently appointed executive vice president of Shell Oil.

* * *

Charles S. Jones, president of Richfield Oil Corp., Los Angeles, has been elected to the board of trustees of the California Institute of Technology, Pasadena, Calif.

* * *

C. A. Knight, who recently retired as chief engineer of Magnolia Petroleum Co.'s refinery at Beaumont, has joined James P. O'Donnell, Engineers, as district representative for the Gulf Coast district.

* * *

R. C. McCurdy has been named president of Shell Chemical Corp., New York, to succeed **Jan Oostermeyer,** who has announced his intention to retire May 31st. Mr. McCurdy is general manager of the Royal Dutch Shell companies in Venezuela.

Mr. Oostermeyer became assistant to the president of Shell Chemical in 1939, was made vice president in 1941, and has been president since 1942. He has seen 36 years of service with various Shell companies. He will remain in an advisory capacity with the company until the end of the year.

* * *

Willard F. Wadt is now general superintendent of the Bayonne refinery of Esso Standard Oil Co., having been its assistant general superintendent since 1948. He succeeds **George A. Esty,** who will retire this fall. **Charles Leet** is now manager of the refinery.

Mr. Wadt

Mr. Leet

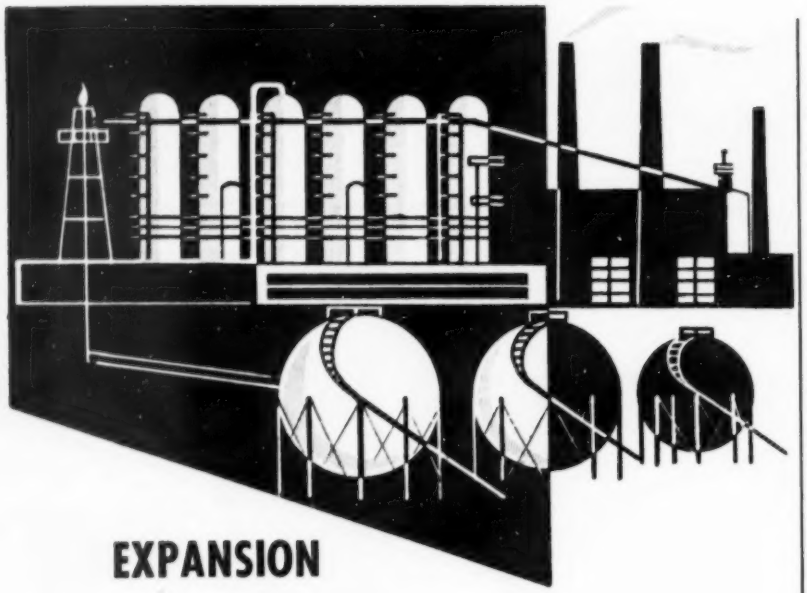
Mr. Wadt was born in West Henrietta, N. Y. and educated in Rochester, graduating from the University of Rochester in 1931. He received an MS degree from MIT in 1933 and joined Esso in Bayonne as a test engineer. He served in administrative capacities in the phenol plant and in the Paraffin Department, and as process superintendent. In 1945 he became coordinator of process operations of the New Jersey Works and in 1946 assistant to the vice president in charge of manufacturing.

Mr. Esty, before joining Esso in 1916, was employed by the Central RR. and Tide Water Associated Oil Co. His 37 years with Esso included assignments in Halifax, Montreal, Havana, Sumatra and Port Jerome, France. During 1917-19 he served with the U. S. Navy. After a vacation, he will act as a consultant on special assignments.

Mr. Leet joined the company at its Bayway, N. J. refinery in 1930, following graduation from West Virginia University with a BS degree in chemical enginering. In 1931 he was moved to Baton Rouge, La. as a chemical engineer, becoming head of the process engineering department in 1939, head of the technical division in 1946 and assistant manager at Baton Rouge on Feb. 1, 1950.

* * *

J. P. Warner is now assistant general manager of the Baton Rouge, La. refinery of Esso Standard Oil Co., replacing **Charles Leet.** Mr. Leet has been made manager of Esso's Bayonne, N. J. refinery. Mr. Warner has been connected with the Baton Rouge refinery since 1928, when he



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came as a research chemical engineer. He became asst. director of development and research in 1932, and in 1935 was named to head the Technical Division. In 1940 he was appointed manager of the Chemical Products Division. He went to New York in 1951 as acting head of Esso's Chemical Division, and was later on special assignment in Europe for several months. He returned to Baton Rouge a year ago as general superintendent of the refinery.

In other changes at the refinery:

Dr. F. A. L. Holloway succeeds Mr. Warner as general superintendent. He joined the Baton Rouge refinery in 1939, and since 1950 has been head of the refinery's Technical Division.

G. R. Murrell, previously head of the Petroleum Products Division and with the refinery since 1929, becomes head of the Technical Division.

C. P. Hoyt, asst. general superintendent of the refinery on rotational assignment, becomes head of the Petroleum Products Division. He has been with the company since 1929. His previous position will not be filled at this time.

* * *

R. V. Snankland has been promoted to senior research associate in the Research Department at the Whiting, Ind. laboratories of Standard Oil Co. (Ind.) He has been succeeded as section leader on catalyst research and development by **G. M. Webb.**

In the Analytical Research Division, **H. M. Grubb** has been promoted to section leader, and **C. H. Ehrhardt** and **R. R. Hopkins** to group leaders.

In the Chemical Products Division, **W. E. Kennel** has been promoted to section leader, and **V. J. O'Brien, Jr.,** and **K. C. Peterson** to group leaders.

* * *

Leon Jacolev, after eight years as a chemical engineer in the Technical & Research Division of The Texas Co., has resigned to devote himself to his consulting practice in Montclair, N.J.

* * *

George A. Harrington has joined Indoil Chemical Co. as Market Research Director. He was formerly associated with Mallinckrodt Chemical Works' development activities, prior to which he was with Socony Vacuum Oil Co.'s Chemical Products Division. Dr. Harrington is a graduate of the Univ. of Nebraska and took his doctorate at Northwestern Univ. His previous industrial connections also include Allied Chemical & Dye Corp. and Mellon Institute.

* * *

Dr. Raphael Rosen retired last month from Standard Oil Development Co. after 26 years service, and is now residing in Miami Beach, Fla., with his wife. Dr. Rosen received his degrees from Johns Hopkins U.

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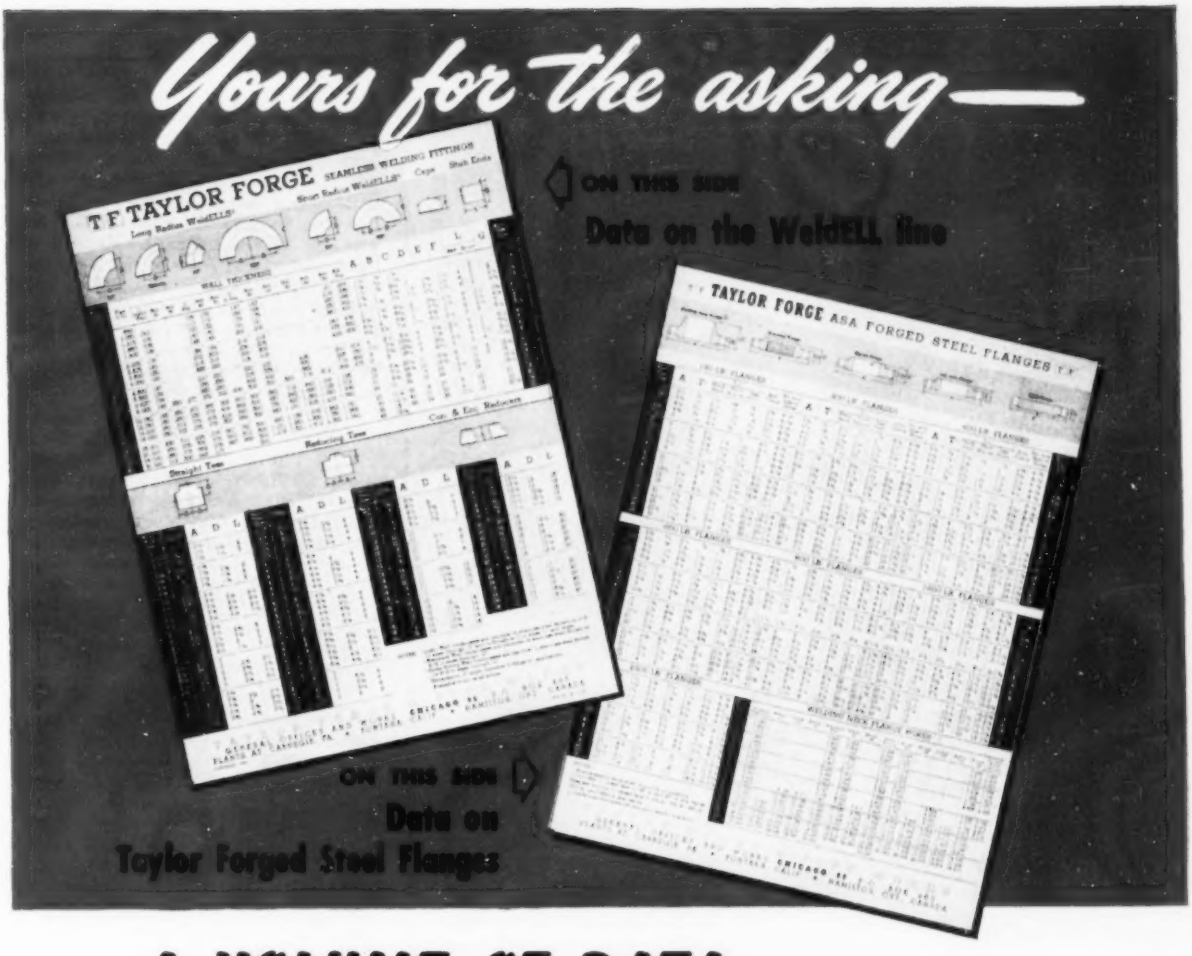
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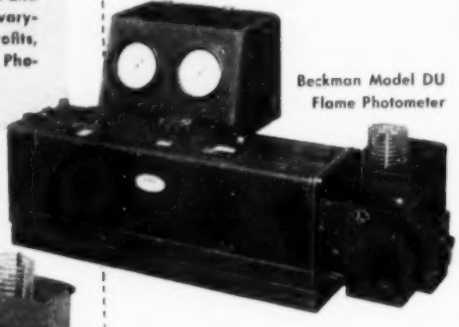

Beckman Model DU Flame Photometer

Beckman Model B Flame Photometer

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To better acquaint you with the many profitable applications for Beckman Flame Photometers, we have prepared a helpful data file which outlines applications, methods and equipment. See your nearest Beckman Instrument dealer for free data.

Or write direct for Data File #20-23

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Beckman Instruments include: pH Meters and Electrodes — Spectrophotometers — Radioactivity Meters — Special Instruments

Personals

and Clark U., and joined the Development Dept. of Standard Oil Co. (N.J.) in 1923. He began his career with Standard Oil Development Co. in 1927, when it was formed, and worked on processes for the commercial manufacture of TEL. He was one of the original members of the Chemical Division of the Development Co. when this division was formed in 1937. During World War II he played an important role in the development of atomic energy, working for both the Manhattan District and the U.S. Atomic Energy Commission, and then returned to the Patent Division of S.O.D.

* * *

Charles I. Wright has taken over as chief engineer at Shell Chemical's Dominguez, Calif., plant, replacing **Clifford L. Merkel,** transferred to Julius Hyman & Co., Denver, Shell subsidiary. Mr. Wright joined Shell in 1934, three years after graduation from the U. of California, and since 1948 has been a senior engineer in Shell's New York office.

* * *

S. C. Harper has been appointed Manager of the Manufacturing and Oil Supply Dept. of Arabian American Oil Co. in New York. He succeeds **D. N. Ezzell,** who will return to Saudi Arabia. Mr. Harper was in the Refining Department of The Texas Co. for 17 years prior to joining Aramco in 1944. After completing two assignments in Saudi Arabia as Supervisor of Research and Development at the Ras Tanura refinery and as Staff Manager of Refining he was made Assistant to Vice President of Technical and Supply Services in New York.

Mr. Harper

* * *

T. Wayne Warren has joined Ethyl Corp. as supervisor of research in refinery technology at the Detroit research laboratories.

Following two years of service as a naval officer in the Pacific, Mr. Warren joined the technical service division of Humble Oil and Refining Co. at Baytown, Texas. For 17 months he was on leave of absence from Humble to serve as an aviation fuels specialist for the Petroleum Administration for Defense in Washington. He is a graduate of the U. of Texas.

With Ethyl, Mr. Warren will be associated with the expansion of research in the field of fuel technology.

* * *

Dr. Gustav Egloff, Director of Research for Universal Oil Products Co., Des Plaines, Ill., was presented The

Washington Award for 1953 last month. The award is conferred by five national engineering societies upon an outstanding engineer for accomplishments which pre-eminently promote the happiness, comfort and well-being of humanity.

* * *

Dr. Hal G. Johnson has been appointed director of research and development for Monsanto Chemical Co.'s Western Division, with headquarters at Santa Clara, Calif. At the same time, **John T. Stephan** was named associate director of research.

Mr. Johnson has been with Monsanto since 1946, and since 1949 has been asst. director of the company's General Development Dept. He is a graduate of Beloit College and U. of Wisconsin, and in the past has worked for Commercial Solvents Corp. and the Dykem Co.

* * *

L. F. Dumont, research engineer in the petroleum laboratory of the duPont Co., received the SAE Horning Memorial Award at the society's 1953 annual meeting in Detroit in January. His 1951 SAE Summer Meeting paper, "Possible Mechanisms by which Combustion Chamber Deposits Accumulate and Influence Knock," was judged "the best paper relating to the adaptation of fuels to internal combustion engines, or the adaptation of internal combustion engines to fuels. . . . "presented at an SAE meeting in 1951. Mr. Dumont received his BS and MS degrees in mechanical engineering from Columbia U., and has been with duPont since 1948.

Mr. Dumont

* * *

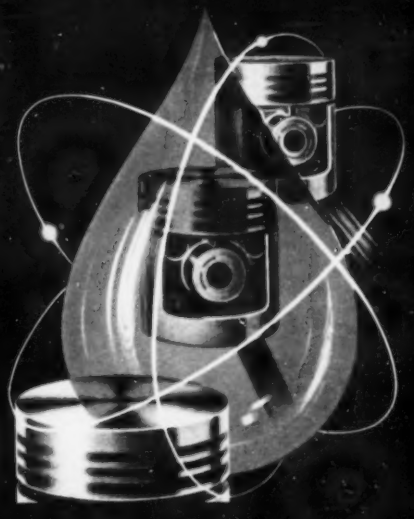
Russell Ward Millar, 57, chief of chemical engineering for Shell Development Co., Emeryville, Calif., died Feb. 24 at his home in Berkeley after a two-month illness.

* * *

Paul W. Prutzman, 76, who built one of the earliest refineries on the West Coast, died Jan. 28 in Los Angeles after a long illness.

Mr. Prutzman began his professional career at the beginning of the century, worked in an asphaltic refinery, then joined the California State Mining Bureau in 1906. Later, he built a refinery in California and practiced consulting petroleum chemistry from 1909 until 1918, when he joined General Petroleum as a chemical engineer at the Vernon (Los Angeles) plant. From 1928 until his retirement in 1948, he was manager of patents for General Petroleum.

Radioactivity used to prove superiority of



Oronite
Lube Oil Additives

Oronite, a major producer of Lube Oil Additives, employs advanced radioactive tracer techniques to achieve superior performance from the Additives it markets.

You will also find Oronite Additives offer important savings in treating costs because of the high quality detergent and inhibitor chemicals from which they are made. And you can always be sure of uniformity in your finished oils.

Why not talk your problems over with us? An Additive specialist will call on you on request. Phone or write the nearest Oronite office.

ORONITE CHEMICAL COMPANY
THE NAME TO WATCH IN CHEMICALS

With Oronite Additives you can formulate oils to meet the new A. P. I. Service Classifications and can meet specifications for 2-104-B, MIL-O-2104, Supplement 1 and Series II oils.

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30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.
STANDARD OIL BLDG., LOS ANGELES 15, CALIF.
600 S. MICHIGAN AVENUE, CHICAGO 5, ILL.
MERCANTILE SECURITIES BLDG., DALLAS 1, TEXAS

(To obtain more data on advertised products see page 424)

traps help uncover hidden steam treasure

The facts are these:

A large southern chemical company about a year ago was up to capacity on their boilers. New process units were being added, requiring more steam—a new boiler seemed inevitable.

About that time they began replacing their old-type traps and bleed-off valves with Yarway Impulse Steam Traps and Strainers. Today, even with the new process units added, their daily steam consumption is nearly 100,000 lbs less than a year ago—the superintendent gives Yarway Impulse Traps credit for the saving.

Yarway Impulse Traps are *designed* to insure sending the most premium B.T.U.'s at top temperature into your product or process . . . *to get equipment hotter sooner and keep it hot!*

Yarway's have 11 other advantages, too—such as *small size, low maintenance, low cost, and availability* from over 200 Industrial Distributors. Write for Bulletin T-1740. Or for steam trap advice, call on your nearby Yarway service engineer.

YARNALL-WARING COMPANY
153 Mermaid Avenue, Philadelphia 18, Pa.

the steam trap designed with more production in mind

Kellogg Staff Changes

Several new executive appointments have been announced recently by M. W. Kellogg Co., New York City.

Joseph W. Smith has been promoted from assistant manager to general manager of construction. A graduate of Michigan with a B.S. in civil engineering, he joined the firm's construction department in 1936.

Henry P. Wickham, long associated with the company's Fluid catalytic processing developments, has been named to manage the expanded operating division. His duties will be to help broaden technical service efforts to include the interests of refiners engaging today in petrochemical and chemical processing.

Mr. Smith

Mr. Wickham

Mr. Becknell

Mr. Melchior

R. V. Becknell has been appointed manager of the project engineering department; and O. G. Melchior associate manager. Both men were previously project managers. Mr. Becknell will serve as administrative head and, in addition, will be technically responsible for the project engineering on all contract work in North, South, and Central America. Mr. Melchior will be technically responsible on European contracts. G. H. Branscombe and N. W. Lewis, formerly job engineers, have been made project engineers.

Powers Elected President

E. D. Powers has been elected president of Chemical Construction Corp., New York City. He will remain as vice president and director of the parent firm, American Cyanamid Co. Major General William N. Porter, who has been Chem Construction's president since 1947, was elected chairman of the board.

Mr. Powers, who has also been elected a director and member of the executive committee for the construction firm, has been with Cyanamid since 1918. General Porter was chief of the Chemical Warfare Service from 1941 to 1945, when he retired from the Army to become associated with American Cyanamid. He is a director of Ultrasonic Corp. and of Chemical Construction (Inter-American) Ltd.

Schutte & Koerting Elects

Schutte and Koerting Co., in a special stockholders' meeting in January, elected the following new officers: Mrs. Helene Koerting Fischer, president to chairman of the board; U. W. Fischer, vice president to president; F. Boehm, chief engineer to vice president in charge of engineering; and F. L. Seibold, sales manager to vice president in charge of sales.

Alco Names Sales Heads

Four appointments have been announced in the sales organization for Alco Products Division of American Locomotive Co. A. T. Lawrance was named regional manager in charge of sales offices at Houston, Tulsa, Los Angeles, and Beaumont. These duties are in addition to his present assignment as manager of the Beaumont Iron Works, an Alco subsidiary.

Paul W. Geisler will be regional manager for district offices in New York, Dunkirk, N. Y., and Chicago. Walter E. Beline replaced Mr. Geisler as district manager for the New York division, and L. W. Eger was appointed manager, sales-service for the Alco Products Division at Dunkirk.

Named Engineering Director

Henry F. Peters, formerly project manager, has been made director of engineering in charge of project and production engineering for the engineering division of Scientific Design Co., New York. He joined the company in 1948 and had served as project manager until his recent promotion.

Previously, Mr. Peters was a mechanical engineer and later a process design engineer for M. W. Kellogg Co. Before that, he was with du Pont as field engineer in the chemical plant construction division. He is a chemical engineering graduate of Cooper Union and a member of the AIChE.

O'Donnell Serves Government

John J. O'Donnell, president of the National Constructors Association, has been named as one of the industry representatives on a 15-member committee of labor, industry, and

ALL-GLASS WALL in north side of Edward Valves' new engineering building at East Chicago, Ind., provides helpful natural light for huge drafting room which takes up 80% of the building area. The new structure is adjacent to the laboratory and research building to simplify liaison between the departments.

New concept of

CORROSION CONTROL

based on liquid Neoprene

—proved in use by Pennsalt and other large companies—a practical, money-saving system employing Pennsalt's corrosion-proof NeoCoat for greater thickness with fewer coats

Now Pennsalt offers a protective coating system based on a new concept: the economic advantages of high build per coat—PLUS the chemical inertness of Neoprene. And it's a method your own maintenance painting crew can use.

For more than two years this system has been under test *in actual operating plants*—tested against 62 common coating systems. Pennsalt's system—using NeoCoat and its companion products—has proved far more effective and, in the long run, considerably more economical.

The Pennsalt NeoCoat system, including special primers and top coats, is now available to all industries plagued by difficult corrosion problems. To help you choose and use these materials on your particular applications, Pennsalt "corrosioneering" specialists are ready to contribute their unparalleled experience in this field.

Complete data—without obligation—is yours for the asking. Address: Corrosion Engineering Products Dept., Pennsylvania Salt Manufacturing Company, 110 Widener Bldg., Philadelphia 7, Pa.

PROGRESSIVE CHEMISTRY FOR OVER A CENTURY

Pennsalt Chemicals

public officials appointed by Secretary of Labor Martin P. Durkin to advise the Eisenhower administration on labor policies.

Mr. O'Donnell is personnel and labor relations manager of The Lummus Co. Prior to joining Lummus shortly after World War II, he had been personnel director for the Eclipse-Pioneer Div. of Bendix Aviation Corp. Before his recent election to a second term as president of the National Constructors Association he had been chairman of the NCA labor committee.

Vulcan Adds Two Engineers

Two new engineers have been appointed to the staff of the Vulcan Engineering Div., Vulcan Copper & Supply Co., Cincinnati. Wilfred Gains, as project engineer, will be engaged in the design and construction of high pressure synthesis plants. A graduate of McMaster University, Hamilton, Ont., Mr. Gains has for the past 12 years been associated with Chemical Construction Corp. in New York City.

Mr. Gains

Mr. Hokanson

Allan Hokanson, a development engineer, was previously with the research and development department of Colgate-Palmolive-Peet Co., Jersey City, N. J., where he worked on the spray drying of detergents. He is a graduate of the Brooklyn Polytechnic Institute.

Personnel Changes

Rockwell Mfg. Co. — Gilbert T. Bowman to sales manager of both Nordstrom and Gas Products Divisions, M. J. Harper as vice president and H. Gottwald as eastern regional manager of sales of the Meter and Valve Division.

Beckman Instruments, Inc.—James D. Wilkinson to manager of market research, at Fullerton, Calif.

Houdry Process Corp.—John B. Okie to director. Mr. Okie is vice

(To obtain more data on advertised products see page 424)

president and director of World Commerce Corp.

Consolidated Engrg. Corp.—Hugh F. Colvin to vice president and treasurer.

Brown Fintube Co. — H. F. Maloney, Jr. to manager of sales in the Cleveland district, from a post as estimating engineer.

Carbide and Carbon Chemicals Co. —H. D. Hughes to general sales manager and E. E. Fogle to sales manager of the industrial chemicals division.

Electric Steel Foundry Co.—Scott Kunkel to Los Angeles manager of sales, from staff chemical engineer.

Roots-Connersville Blower Div., Dresser Industries Inc.—E. D. Roudebush to vice president and works manager, from assistant to the vice president in charge of manufacturing.

Girdler Corp.—Wallace A. Gray to New York sales staff of the Votator Division, from the field service and engineering staff.

Black, Sivalls & Bryson Inc. — Chester A. Siver to general manager of engineering, with headquarters at Kansas City.

Branches, Distributors

C. B. Antill and Co., engineers and constructors of New York, Toronto, Edmonton, and Calgary has opened a new general office at 4814 Ayers, Corpus Christi, Texas.

Pennsylvania Salt Mfg. Co. has appointed Mr. Henry S. Rondeau and the Cleveland Industries Co., 1935 Euclid Ave., Cleveland, as representatives in Ohio and northern Kentucky.

Pennsylvania Flexible Metallic Tubing Co., Philadelphia, has appointed Murray-Baker-Frederic, Inc., 626 S. Peters St., New Orleans 6, La., as their distributor in the territory covering New Orleans, Mobile, Baton Rouge, Jackson, and neighboring communities.

The Foxboro Co. has opened a new branch office at 2207 South Pinecrest, Wichita, Kans., with Dale C. Hugley as resident engineer, who moved up from the Tulsa branch where he was industrial engineer.

M. W. Kellogg Co. has established new warehousing facilites for Kel-F at Vernon, Calif., to provide service for that state, Oregon, Washington, Arizona, Nevada, and Utah.

Protect Against Overpressure from within Pressure Vessels with

BS&B Safety Heads

We make the rupture discs for BS&B Safety Heads out of these rolls of thin ductile metal. These rolls are only a few examples of our supply.

You see, rupture discs—which insure protection against overpressure for hundreds of types of pressure vessels in the petroleum, chemical processing and power industries—must be accurate within 5% of their various rated pressures of 5 to 40,000 pounds. Out of every lot we make, 1 disc out of every 6, selected at random, is tested to destruction to insure this accuracy.

It has taken years of research to know exactly what metals do each job best—for the pressures involved, for the liquids or gases involved depending on their corrosive or bland nature.

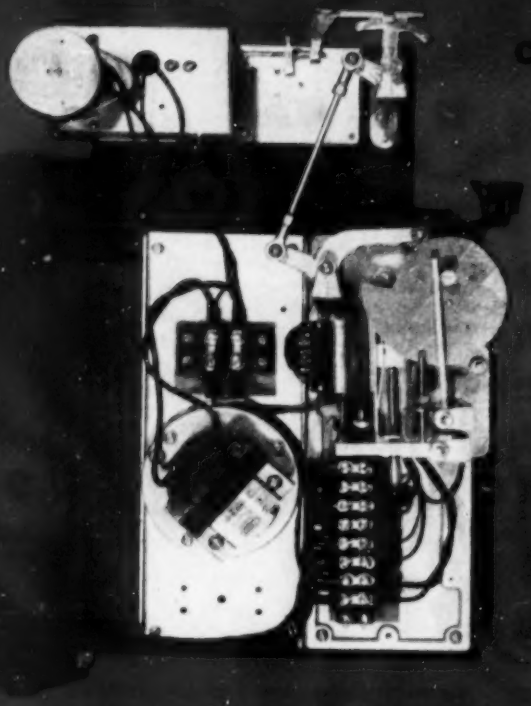
All this research has made BS&B Safety Heads and their rupture discs the world's accepted standard for secondary (and often primary) protection against pressures. That's why they're code-accepted—and guaranteed.

Get all the facts: No matter what your pressure applications are, there's a Safety Head for you. Write for complete BS&B Safety Head Catalog . . . or ask your BS&B Man. There's no obligation for a complete analysis of your pressure safety requirements.

SAFETY BS&B HEADS OUR 60TH YEAR

BLACK, SIVALLS & BRYSON, INC.
Safety Head Division, Dept. 2-D3
7500 East 12th Street Kansas City 26, Missouri

a new electronic flow meter!



Choice of 3 mercury-less transmitters

Hays Barton flow or differential transmitter

Hays differential transmitter

Hays liquid level transmitter

continuous integration —no creep at zero

unaffected by normal voltage, frequency and temperature changes

electronic operation provides high speed and greater accuracy

3 to 1 range calibration at recorder

HAYS Electronic Flow Meter

Since the circuit is of the electronic null-balance type, it is unaffected by normal voltage and frequency variations. Also, neither temperature variations nor reasonable length of transmission lines affect the calibration of the instrument.

The *pen-drive motor* is built for reversing duty. Normal variations in voltage and frequency have no noticeable effect on its operation.

The *integrator* is continuous in operation and simple in mechanical construction. A micrometer zero adjustment for calibration is easily accessible.

Indicators can be calibrated to read directly in rate-of-flow or other factors as desired.

Write today for full information on the Hays Electronic Flow Meter Bulletin 52-1074-222.

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Boiler Panels • Hays-Penn Flowmeters
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Electronic Oxygen Recorders
Electronic Flowmeters
Electronic Feed Water Controls
Miniature Remote Indicators

THE hays CORPORATION

MICHIGAN CITY 23, INDIANA

Annual Refining Division Meeting Offers Wide Range of Subjects

NEW processes, corrosion, analytical research, electrical equipment, gasoline volatility, training, motor fuels, and lube oils are the topics on the docket for the 18th midyear meeting of the American Petroleum Institute's Division of Refining at New York City's Commodore Hotel, May 11-14.

Four processes will be discussed during the Wednesday afternoon session, May 13: autofining, Shell's hydrodesulfurization, Socony-Vacuum's TCP—Thermofor continuous percolation, and Houdriforming. Corrosion subjects scheduled for discussion in two different sessions, Monday morning, May 11, and Tuesday morning, May 12, include graphitization, use of organic inhibitors, deterioration in cooling towers, and economics.

Two sessions have also been set up with papers on a wide variety of aspects in analytical research, test methods, equipment used, statistical techniques, and the like. There are also two sessions arranged for discussions of refinery electrical equipment.

A detailed program follows:

Monday, May 11, 9:00 a.m.

ANALYTICAL RESEARCH

"The Direct Determination of Oxygen in Organic Compounds," a report of the Subcommittee on Analysis of Oxygenated Compounds, Committee on Analytical Research; W. H. Jones, chairman, Esso Standard Oil Co., Louisiana Div., Baton Rouge.

"Determination of Hydrocarbons and Phenols in Refinery Effluent Waters," a report of the Subcommittee on Refinery Effluent Water Analytical Methods, Committee on Analytical Research; C. E. Headington, chairman, Atlantic Refining Co.

"Direct Extraction-Pycnometer Method for Oil Content of Refinery Effluents," W. S. Levine, G. S. Mapes, and M. Roddy, Socony-Vacuum Laboratories, Brooklyn, N. Y.

"Mass Spectrometric Determination of Volatile Contaminants in Water," F. W. Melpolder, C. W. Warfield, and C. E. Headington, Atlantic Refining Co., Phila., Pa.

"The Pumpability of Fuel Oil," F. Gill and R. P. Russell, Anglo-Iranian Oil Co., Sunbury-on-Thames, England.

"The Application of Metal Valves on Low Temperature Distillation Apparatus," R. A. Brown and D. J. Skahan, Atlantic Refining Co., Phila., Pa.

DETERIORATION OF METALS

"Segregated Graphite in Steel," J. J. Kanter, materials research engineer, Crane Co., Chicago.

"Graphitization in Petroleum Refining Equipment," R. J. Fiorentino and A. M. Hall, Battelle Memorial Institute, Columbus, Ohio.

"Alternate Types of Vessel Construction—a Cost Comparison," I. E. Boberg, chief engineer, Chicago Bridge & Iron Co., Chicago.

Monday, May 11, 2:00 p.m.

ELECTRICAL EQUIPMENT

"Public Utility Power Application to the Oil Industry," P. H. Weinberg, Philadelphia Electric Co.

"Design and Application of Explosion-Proof Equipment," R. P. Northup, commercial vice president, Crouse-Hinds Co., Syracuse, N. Y.

ANALYTICAL RESEARCH

"Statistical Evaluation of the Reproducibility of Testing between Petroleum Refinery Inspection Laboratories," W. H. White, Imperial Oil Co. Ltd., Sarnia, Ont., and D. S. McArthur, Esso Laboratories—Research Division, Linden, N. J.

"How to Evaluate a Test Procedure," D. S. McArthur and E. L. Baldeschwieler, Esso Laboratories—Research Division; and W. H. White, Imperial Oil Ltd., and J. S. Anderson, Esso Standard Oil Co., Louisiana Div., Baton Rouge.

A. "A Statistical Study of Semimicro Methods of Analyses of Ashes from Petroleum Stocks," G. V. Dryoff, Esso Laboratories—Research Division.

B. "The Analysis of Petroleum Ashes and Deposits by a Spectrochemical Method," John Hansen and C. R. Hodgkins, Esso Laboratories—Research Division.

C. "A Comparison of Spectrochemical and Semimicro Methods in the Analysis of Petroleum Ashes," G. V. Dryoff, John Hansen, and C. R. Hodgkins, Esso Laboratories.

"The Use of X-Ray Fluorescence in the Analysis of Lubricating Oils for Barium, Calcium and Zinc," Elwin Davis and Robert Van Nordstrand, Sinclair Research Laboratories, Inc., Harvey, Ill.

"Determination of a Hindered Phenol (4-methyl-2, 6-di-tert-butylphenol) in Lubricating Oils by Infrared Absorption," Emil Poty, L. L. Gont, R. C. Pomatti and H. Levin, Beacon Laboratories, The Texas Co., Beacon, N. Y.

"A Direct Spectrographic Method of Analyzing Residual Fuels for Trace Elements," C. W. Key and G. D. Hoggan, Richfield Oil Corp., Wilmington, California.

Tuesday, May 12, 9:00 a.m.

ELECTRICAL EQUIPMENT

"Maintenance of Switchgear in Petroleum Refineries," H. B. Wortman, Supervising Design Engineer, Switchgear Division, Westinghouse Electric Corp., East Pittsburgh, Pa.

"Maintenance of Electrical Motors," F. H. Walker, Supervisor, Electrical Section, Engineering Research Division, Engineering and Construction Department, The Atlantic Refining Co., Philadelphia, Pa.

CORROSION

"Use of Organic Inhibitor for Refinery Corrosion Control," C. C. Hulbert and J. A. Rippetoe, The Pure Oil Co.

"Estimation of Corrosivity of Crude Oils," R. J. Askevold, The Pure Oil Co. and C. Samans, Standard Oil Co. of Indiana.

"Basic Economic Factors of Atmospheric Corrosion vs. Protection," Clarence C. Harvey, Ethyl Corp.

"Deterioration of Redwood Cooling Towers," Roy V. Comeaux, Humble Oil and Refining Co.

Tuesday, May 12, 2:00 p.m.

GASOLINE VOLATILITY

"Effect of Fuel Volatility on Cold Starting and Warmup Performance of Late Model Passenger Cars," K. C. Bier, Ethyl Corp. and R. K. Stone, California Research Corp.

"Volatility of Gasolines and Performance of Passenger Cars," C. J. Domke, C. B. Tracy and H. R. Taliaferro, Standard Oil Co. of Indiana.

"A Review of Vapor-lock Data," Robert Best, Southwest Research Institute.

Wednesday, May 13, 9:00 a.m.

TRAINING

An outstanding session is being planned. The titles of the papers are not yet available.

Wednesday, May 13, 2:00 p.m.

PROCESSES

"The Autofining Process," F. W. B. Porter, Anglo-Iranian Oil Co., England.

"Shell Hydrodesulfurization Process," H. Hoog, H. G. Klinkert and A. Schaafsma, Bataafsche Petroleum Maatschappij (Shell), The Hague, Holland.

"The Thermofor Continuous Percolation (TCP) Process," K. E. Magin, J. E. Saboca, H. W. Shea, Socony-Vacuum Oil Co., Inc., New York, N. Y.

"Houdriforming Economics—Effect of Feed Stock Boiling Range and Reforming Severity," H. D. Noll, T. A. Burtis and J. C. Dart, Houdry Process Corp., Philadelphia, Pa.

OPEN DINNER SESSION, 7:00 p.m.

Presiding: John W. Newton, Vice-President for Refining (American Petroleum Institute); Magnolia Petroleum Co., Beaumont, Texas.

Address: John W. Newton, Vice-President for Refining.

Address: Speaker to be announced.

Thursday, May 14, 9:00 a.m.

MOTOR FUELS

"Comparison of LPG, Gasoline, and Diesel Fuel in City Bus Operation," F. C. Burk, E. S. Black, Atlantic Refining Co., and Harley Swift, Harrisburg Railway Co.

"Preignition in Automotive Engines," J. R. Sabina, J. J. Mikita, M. H. Campbell, DuPont.

"Recycling Exhaust Gases for Suppression of Knock Internal Combustion Engines," A. E. Miller and S. F. Suliss, Sinclair Refining Co.

Thursday, May 14, 2:00 p.m.

LUBRICATING OILS

An interesting program is being arranged. Titles and authors will be announced later.

Oil Man's Calendar

MARCH

Commercial Chemical Development Association, annual meeting, Statler Hotel, New York City, March 23-24.

Western Petroleum Refiners Assn., annual meeting, Plaza Hotel, San Antonio, Texas, Mar. 23-25.

American Society for Metals, Eighth Western Metal Congress and Exposition, Pan-Pacific Auditorium, Los Angeles, Calif., Mar. 23-27.

APRIL

National Petroleum Association, 50th semi-annual meeting, Hotel Cleveland, Cleveland, O., April 15-17.

Packaging Machinery Mfgrs. Institute, semi-annual meeting, Sheraton Hotel, Chicago, Ill., April 18-19.

American Institute of Chemical Engineers, joint meeting with the **Chemical Institute of Canada,** Royal York Hotel, Toronto, Ont., April 26-29.

Natural Gasoline Assn. of America, 32nd annual convention, Rice Hotel, Houston, Texas, Apr. 29-May 1.

MAY

American Petroleum Institute, Division of Refining, mid-year meeting, Hotel Commodore, New York, N. Y., May 11-14.

American Institute of Chemists, annual meeting, Philadelphia, Pa., May 12-13.

International Petroleum Exposition and Congress, Hall of Science, Tulsa, Okla., May 14-23.

Chemical Specialties Mfgrg. Association, mid-year meeting, Drake Hotel, Chicago, Ill., May 17-19.

Materials Handling Exposition, Convention Hall, Philadelphia, Penna., May 18-22.

Scientific Apparatus Makers Association, annual meeting, all sections, The Greenbrier, White Suphur Springs, W. Va., May 24-28.

Western Petroleum Refiners Association, regional meeting, Hotel Broadview, Wichita, Kans., May 28-29.

JUNE

Society of Automotive Engineers, summer meeting, The Ambassador and the Ritz-Carlton Hotels, Atlantic City, N. J., June 7-12.

Manufacturing Chemists Association, joint meeting with **Synthetic Organic Chemicals Mfgrg. Association,** Greenbrier Hotel, White Sulphur Springs, W. Va., June 11-13.

Exposition of Basic Materials for Industry, Grand Central Palace, New York City, June 15-19.

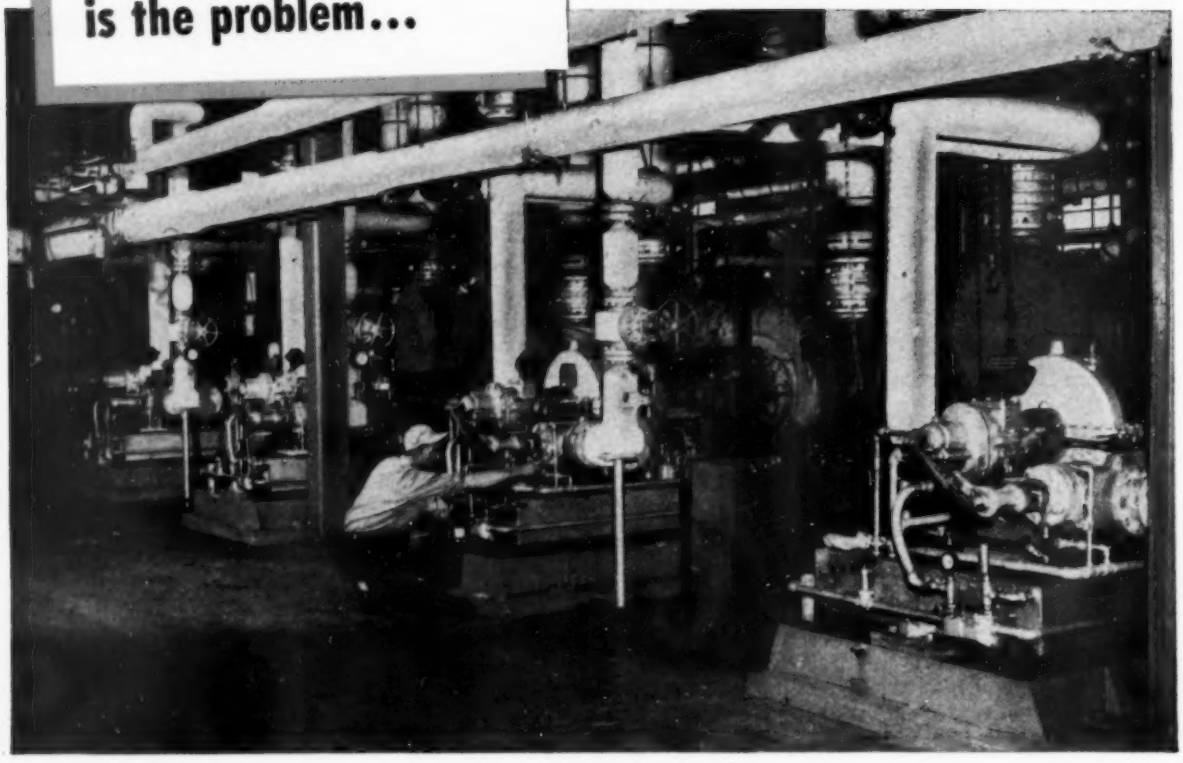
Western Petroleum Refiners Association, regional meeting, Conrad Hilton Hotel, Chicago, Ill., June 18-19.

American Society for Testing Materials, annual meeting, Atlantic City, N. J., June 29-July 3.

SEPTEMBER

American Institute of Chemical Engineers, regional meeting, Fairmont and Mark Hopkins Hotels, San Francisco, Calif., Sept. 13-16.

Where fluctuating load is the problem...



TYPE E gearturbines can handle it!

Process requirements in the evaporator room of the Masonite Plant, Ukiah, California, called for a variable-speed pump drive to provide for fluctuating load conditions. Steam was available. In the words of this user: "Westinghouse Type E, Close-coupled Gearturbines were selected since the pumps had to operate at relatively low speeds, and the higher efficiency inherent in the high-speed turbines was desirable. In operating performance, these turbines have proved the most efficient and economical solution to our problem."

Also in the evaporator room, the Masonite Company selected four Westinghouse Type E Turbines to drive the boiler feed pumps. These turbines provide an efficient, trouble-free drive which can be driven by the existing steam supply. Motor-driven units are used as stand-bys.

This use of both types of Westinghouse Turbines is the kind of over-all unit responsibility that actually makes your job of purchasing, installation, and maintenance easier . . . more dependable.

Wrapped up in a single package is a compact, rugged, and reliable speed-reduction unit solidly coupled to a Type E turbine. Each gearturbine is mounted on an extremely rugged base, fabricated of heavy steel plate which forms the oil reservoir. This arrangement simplifies mounting and installation. It provides operating stability never before available.

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TYPE E Turbines

Gasoline Stocks East of California May Reach 150,000,000 Bbls. In April

THE continued high rate of refinery operations the past few months has led to a larger buildup of gasoline stocks, and a smaller reduction of heating oil stocks, than a year ago. The most important aspect of this currently is that gasoline stocks at refineries, at the start of the withdrawal season in early April, will likely stand at a substantially higher level than at any time previously. These stocks east of California may reach 150,000,000 bbls.

For the first three weeks of February refiners were running an average of 6,977,000 b/d of crude. This was 370,000 bbls. more than for the same period in February, '52 (API data). East of California runs were approx. 300,000 bbls., 5.3%, higher than the preceding February. East Coast refiners were running nearly 7% more crude, Gulf Coast plants 3.8% more crude. Total runs for the Eastern and Gulf Coast seaboard districts were 4.7% larger. In the large Ind-Ill.-Ky. refining district, crude runs were 4.0% larger than a year ago. Table 1 shows the comparable figures for the various refining districts of the U. S.

Current runs, however, are well under operable capacities in all refining districts, or at least under the API estimates of operable capacity on March 31, which are also given in Table 1. The total estimated capacity for the country of 7,669,000 b/d is nearly 10% greater than actual February runs. East of California estimated capacity is about 8% larger than February runs.

Gasoline Situation—Refinery gasoline stocks for the U. S. on Feb. 21 were 155,857,000 bbls., nearly 5,000,000 bbls. greater than on Feb. 23, '52, (API data). East of California, stocks this year of 139,598,000 bbls. were about 4,700,000 bbls. (3.5%) larger than on Feb. 23, '52.

The higher current volume of gasoline stocks is not the entire story, however. East of California stocks have been built up to this figure of 139,598,000 bbls. by nearly 37,000,000 bbls. from the low level of around 102,700,000 bbls. on Sept. 1, '52. The comparable buildup from the low point of 109,700,000 bbls. on Sept. 1, '51, to 134,876,000 bbls. Feb. 23, '52 was not much over 25,000,000 bbls. The gasoline stocks increase in the early part of 1952 also was in anticipation of the strike of refinery workers in May.

By early April a year ago gasoline stocks at refineries had been built up to about 142,000,000 bbls. east of California and during the period of the strike in May they were reduced by some 33,000,000 bbls. The rate of increase of stocks in recent weeks has been somewhat higher than during the same weeks in 1952. If this rate of increase continues, under normal conditions, gasoline stocks at refineries east of California by April might reach 150,000,000 bbls.

Heating oil stocks—Kerosine and distillate fuels stocks for the entire U. S. were 92,787,000 bbls. on Feb. 21. This volume was 13,389,000 bbls. (nearly 17%) larger than the 79,398,000 bbls. in refiners' tanks Feb. 23, 1952. East of California these stocks of Feb. 21 were 82,486,000 bbls., about 13% larger than the 72,727,000 bbls. in tanks on Feb. 23, 1952. In the current heating season these stocks have been reduced by approximately 60,000,000 bbls. from their high point of 142,560,000 bbls. on Oct. 25, 1952.

In the 1951-52 season heating oil stocks stood at a peak of 134,871,000 bbls. on Oct. 27, '51, and were reduced by around 62,100,000 bbls. to approximately 72,700,000 bbls. on Feb. 23, 1952. The slightly smaller reduction this heating season likely reflects the milder winter over a good section of the country, as well as the larger current output at refineries.

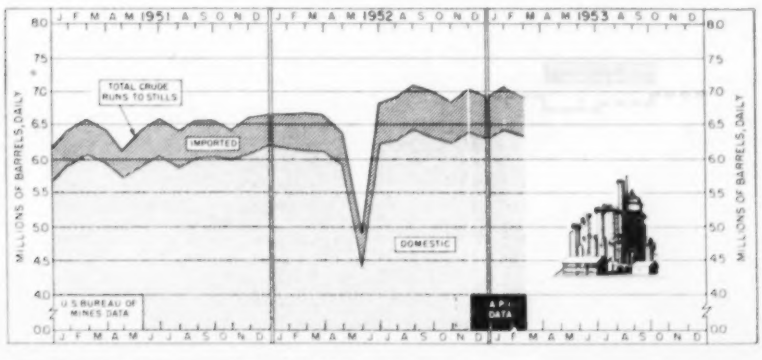
By March 29 last year heating oil stocks had been reduced by a further 14,000,000 bbls. east of California, and stood at 58,900,000 bbls. A reduction of about the same rate this year, unless the late weeks of winter are unusually severe, might leave heating oil stocks east of California at around 70,000,000 bbls., considerably higher than their low point a year ago.

Table 1—Runs to Stills, by Refining Districts, Feb. 1952-1953 and Estimated Operable Capacity March 31, 1953 (API Data 1000 Bbls. Daily)

District	Feb.* '53	Feb. '52	Change	% Change	Oper. Cap. March 31, '53
East Coast	1,030	965	+ 65	6.7	1,107
Gulf Coast	2,234	2,153	+ 81	3.8	2,377
Total Coastal	3,264	3,118	+146	4.7	3,484
Appalachian	210	194	+ 16	8.2	211
Ind.-Ill.-Ky.	1,290	1,240	+ 50	4.0	1,404
Okla.-Kans.-Mo.	585	549	+ 36	6.6	651
Other Inland	604	553	+ 51	9.2	681
Total East of Calif.	5,953	5,654	+299	5.3	6,431
California	1,024	953	+ 71	7.5	1,238
Total U. S.	6,977	6,607	+370	5.6	7,669

* First three weeks.

Fig. 1—Runs to Stills Close to 7,000,000 b/d


J F M A M 1951 A S O N D
J F M A M 1952 A S O N D
J F M A M 1953 A S O N D
MILLIONS OF BARRELS, DAILY
TOTAL CRUDE RUNS TO STILLS
IMPORTED
DOMESTIC
U.S. BUREAU OF MINES DATA
API DATA

Crude Runs to Stills

Daily Average (1000 bbls.)

	Domestic	Foreign	TOTAL
Feb. '53 API*	6,391	586	6,977
Feb. '52 BM	6,180	493	6,673
Change	+211	+93	+304
% Change	3.4	19.0	4.6

* Through Feb. 21

Total (1000 bbls.)
(Bureau of Mines Data)

12 Mos. '52*	2,234,399	206,124	2,440,523
12 Mos. '51	2,188,677	181,727	2,370,404
Change	45,722	24,397	70,119
% Change	2.1	13.4	3.0

*Dec. estimated from API data

BM Forecast of Crude Runs to Stills, 1953
(Dec. 26, 1952; 1000 b/d avg. by quarters)

1st Q., 6,920 2nd Q., 6,750 3d Q., 6,810 4th Q., 6,972

Yields on Crude Runs to Stills

	Gasoline %	Kerosine %	Dist. Fuels %	Resid. Fuels %
Feb. '53 API*	44.2	5.8	21.6	18.1
Jan. '53 API	43.5	5.8	22.1	18.3
Dec. '52 API	44.3	6.1	21.9	18.5
Feb. '52 BM	41.8	5.5	22.6	19.6

*Through Feb. 21

Fig. 2—Gasoline Output Holds High Level

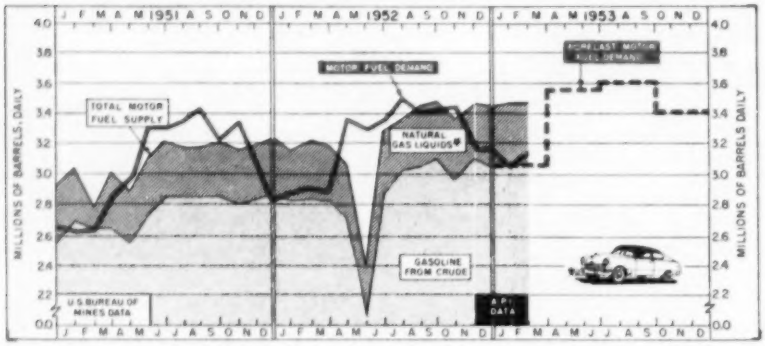

J F M A M 1951 A S O N D
J F M A M 1952 A S O N D
J F M A M 1953 A S O N D
MILLIONS OF BARRELS DAILY
TOTAL MOTOR FUEL SUPPLY
MOTOR FUEL DEMAND
NATURAL GAS LIQUIDS
GASOLINE FROM CRUDE
FORECAST MOTOR FUEL DEMAND
U.S. BUREAU OF MINES DATA
A.P.I. DATA

Fig. 3—Gasoline Stocks Are Climbing

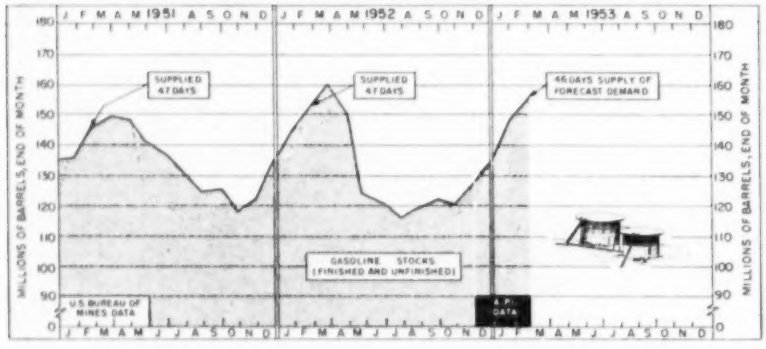

J F M A M 1951 A S O N D
J F M A M 1952 A S O N D
J F M A M 1953 A S O N D
MILLIONS OF BARRELS, END OF MONTH
SUPPLIED 47 DAYS
SUPPLIED 47 DAYS
46 DAYS SUPPLY OF FORECAST DEMAND
GASOLINE STOCKS (FINISHED AND UNFINISHED)
U.S. BUREAU OF MINES DATA
A.P.I. DATA

Fig. 4—Heating Oil Demand Drops in Feb.

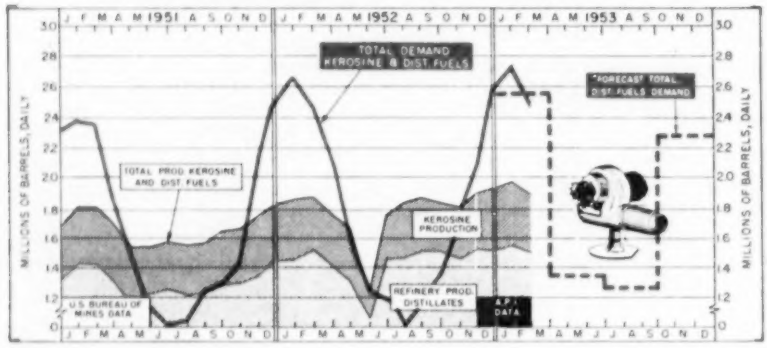
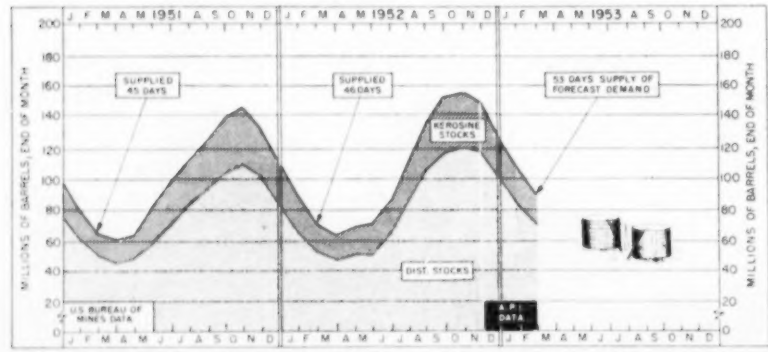

J F M A M 1951 A S O N D
J F M A M 1952 A S O N D
J F M A M 1953 A S O N D
MILLIONS OF BARRELS, DAILY
TOTAL DEMAND KEROSINE & DIST. FUELS
"FORECAST" TOTAL DIST. FUELS DEMAND
TOTAL PROD. KEROSINE AND DIST. FUELS
KEROSINE PRODUCTION
REFINERY PROD. DISTILLATES
U.S. BUREAU OF MINES DATA
A.P.I. DATA

Fig. 5—Moderate Drop on Heating Oil Stocks


J F M A M 1951 A S O N D
J F M A M 1952 A S O N D
J F M A M 1953 A S O N D
MILLIONS OF BARRELS, END OF MONTH
SUPPLIED 45 DAYS
SUPPLIED 46 DAYS
53 DAYS SUPPLY OF FORECAST DEMAND
KEROSINE STOCKS
DIST. STOCKS
U.S. BUREAU OF MINES DATA
A.P.I. DATA

Motor Fuel Supply

Daily Average (1000 bbls.)

	Gasoline from Crude	Natural Blended Used Direct	TOTAL
Feb. '53 API*	3,082	385	3,467
Feb. '52 BM	2,829	382	3,211
Change	+253	+3	+256
% Change	9.0	1.0	8.0

*Through Feb. 21

Total (1000 bbls.)
(Bureau of Mines Data)

12 Mos. '52*	1,052,370	138,766	1,191,136
12 Mos. '51	1,009,630	129,881	1,139,511
Change	+42,740	+8,885	+51,625
% Change	4.2	6.8	4.5

*Dec. estimated from API data

Motor Fuel Demand

Including Exports

Daily Average (1000 bbls.)

Feb. '53 API*	3,162
Feb. '52 BM	2,923
Change	+239
% Change	8.2

*Through Feb. 21

Total (1000 bbls.)
(Bureau of Mines Data)

12 Mos. '52*	1,189,149
12 Mos. '51	1,130,584
Change	58,565
% Change	5.2

*Dec. estimated from API data

BM Forecast of Motor Fuel Demand, 1953
(Dec. 26, 1952; 1000 b/d avg. by quarters)

1st Q., 3,055 2nd Q., 3,560 3d Q., 3,609 4th Q., 3,402

Gasoline Stocks

Finished and unfinished, end of month (1000 bbls.)

Feb. '53 API*	155,857
Jan. '53 API	149,443
Dec. '52 API	135,905
Feb. '52 BM	151,912

*Feb. 21

Heating Oils Production

(Kerosine and Distillates)

Daily Average (1000 bbls.)

	Kerosine	Dist. Fuels	TOTAL
Feb. '53 API*	403	1,506	1,909
Feb. '52 BM	370	1,528	1,898
Change	+33	−22	+11
% Change	9.0	1.4	

*Through Feb. 21

Total (1003 bbls.)
(Bureau of Mines Data)

12 Mos. '52*	132,383	521,616	653,999
12 Mos. '51	135,742	475,801	611,543
Change	−3,359	+45,815	+42,456
% Change	2.4	9.6	6.9

*Dec. estimated from API data

Heating Oils Demand

Daily Average (1000 bbls.)

	Kerosine	Dist. Fuels	TOTAL
Feb. '53 API*	495	2,016	2,511
Feb. '52 BM	514	1,945	2,459
Change	−19	+71	+52
% Change	3.7	3.7	2.1

*Through Feb. 21

Total (1000 bbls.)
(Bureau of Mines Data)

12 Mos. '52*	131,829	512,660	644,489
12 Mos. '51	130,532	471,751	602,283
Change	+1,297	+40,909	+42,206
% Change	1.0	8.6	7.0

*Dec. estimated from API data

BM Forecast of Heating Oils Demand, 1953
(Dec. 26, 1952; 1000 b/d avg. by quarters)

1st Q., 2,566 2nd Q., 1,352 3d Q., 1,250 4th Q., 2,272

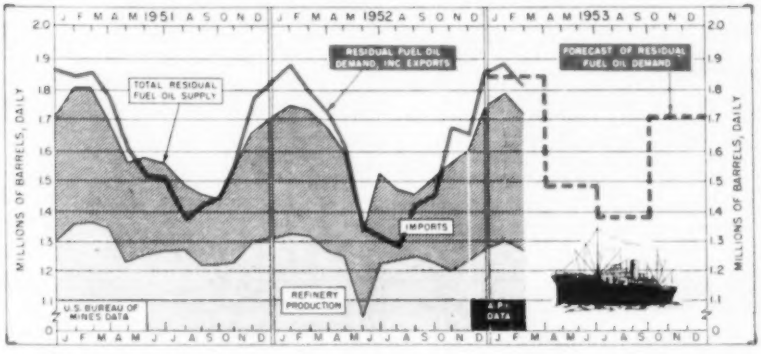
Heating Oil Stocks

(1000 bbls. end of month)

	Kerosine	Dist. Fuels	TOTAL
Feb. '53 API*	21,357	71,430	92,787
Jan. '53 API	23,292	82,148	105,440
Dec. '52 API	27,490	101,843	129,333
Feb. '52 BM	18,530	55,369	73,899

*Feb. 21

Fig. 6—Steady Refinery Output of Residuals


J F M A M 1951 A S O N D
J F M A M 1952 A S O N D
J F M A M 1953 A S O N D
RESIDUAL FUEL OIL DEMAND, INC. EXPORTS
FORECAST OF RESIDUAL FUEL OIL DEMAND
TOTAL RESIDUAL FUEL OIL SUPPLY
IMPORTS
REFINERY PRODUCTION
A.P.I. DATA
U.S. BUREAU OF MINES DATA
MILLIONS OF BARRELS, DAILY

Residual Fuels Production

Daily Average (1000 bbls.)

	Refinery Output	Imports	TOTAL
Feb. '53 API*	1,266	451	1,717
Feb. '52 BM	1,322	409	1,731
Change	−56	+42	−14
% Change	4.2	10.2	1.0

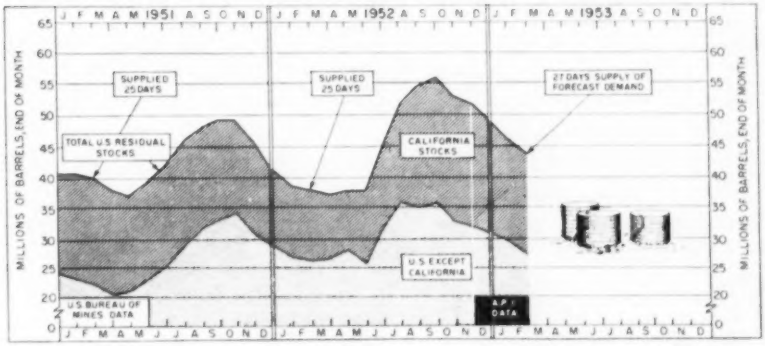
*Through Feb. 21

Total (1000 bbls.)
(Bureau of Mines Data)

12 Mos. '52*	454,175	126,089	580,264
12 Mos. '51	469,377	118,675	588,052
Change	−15,202	+7,414	−7,788
% Change	3.2	6.2	1.3

*Dec. estimated from API data

Fig. 7—"Resid" Stocks Continue to Decline


J F M A M 1951 A S O N D
J F M A M 1952 A S O N D
J F M A M 1953 A S O N D
SUPPLIED 25 DAYS
SUPPLIED 25 DAYS
27 DAYS SUPPLY OF FORECAST DEMAND
TOTAL U.S. RESIDUAL STOCKS
CALIFORNIA STOCKS
U.S. EXCEPT CALIFORNIA
A.P.I. DATA
U.S. BUREAU OF MINES DATA
MILLIONS OF BARRELS, END OF MONTH

Residual Fuels Demand

Daily Average (1000 bbls.)

Feb. '53 API*	1,812
Feb. '52 BM	1,794
Change	+18
% Change	1.0

*Through Feb. 21

Total Demand (1000 bbls.)

12 Mos. '52*	578,937
12 Mos. '51	592,745
Change	−13,808
% Change	2.3

*Dec. estimated from API data

BM Forecast Residual Fuels Demand, 1953
(Dec. 26, 1952; 1000 b/d avg. by quarters)

1st Q., 1,845 2nd Q., 1,494 3d Q., 1,370 4th Q., 1,707

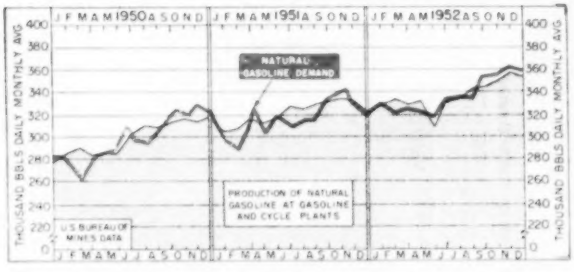
Residual Fuel Stocks

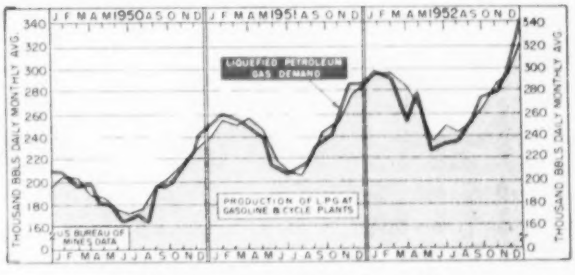
1000 bbls. end of month

	U.S. Except California	TOTAL U.S.
Feb. '53 API*	27,208	44,364
Jan. '53 API	29,284	46,456
Dec. '52 API	31,226	49,117
Feb. '52 BM	27,024	38,295

*Feb. 21

Fig. 8—Supply and Demand of Natural Gas Liquids


J F M A M 1950 A S O N D
J F M A M 1951 A S O N D
J F M A M 1952 A S O N D
NATURAL GASOLINE DEMAND
PRODUCTION OF NATURAL GASOLINE AT GASOLINE AND CYCLE PLANTS
U.S. BUREAU OF MINES DATA
THOUSAND BBLS DAILY MONTHLY AVG.


J F M A M 1950 A S O N D
J F M A M 1951 A S O N D
J F M A M 1952 A S O N D
LIQUEFIED PETROLEUM GAS DEMAND
PRODUCTION OF LPG AT GASOLINE & CYCLE PLANTS
U.S. BUREAU OF MINES DATA
THOUSAND BBLS DAILY MONTHLY AVG.

Natural Gas Liquids Statistics

(Source: U. S. Bureau of Mines Report on Natural Gasoline and Cycle Plant Operations)

	Supply* (1000 bbls./day avg.) Natural Gasoline	LPG	TOTAL	Demand** (1000 bbls./day avg.) Natural Gasoline	LPG	TOTAL
Dec. '52*	353	323	676	359	340	699
Dec. '51	325	285	610	320	285	605
Change	+28	+38	+66	+39	+55	+94
% Change	8.6	13.3	10.8	12.2	19.3	15.5
	Total Supply (1000 bbls.)			Total Demand (1000 bbls.)		
12 Mos. '52*	123,120	100,352	223,472	123,863	99,429	223,292
12 Mos. '51	116,977	86,377	206,354	115,383	87,936	203,319
Change	+3,143	+13,975	+17,118	+8,480	+11,493	+19,973
% Change	2.6	16.2	8.3	7.3	13.1	9.8

Stocks, End of Month (1000 bbls.)

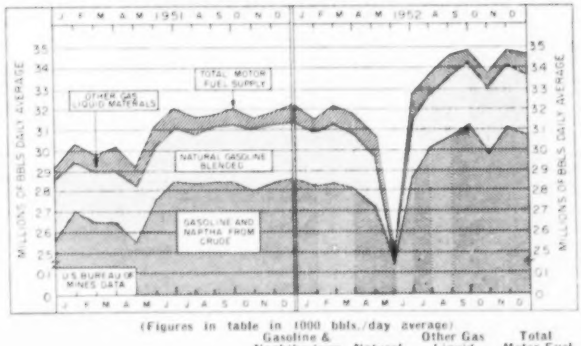
	By type of product (At gasoline plants and terminals only) LPG	Natural Gasoline	Condensate	Finished Gasoline†	By Location Gasoline Plants	Refineries	Total
Dec. '52	2,191	2,411	315	1,207	5,724	2,083	7,807
Nov. '52	2,744	2,153	294	1,287	6,458	2,126	8,584
Oct. '52	2,892	2,299	263	1,185	6,739	2,151	8,890
Sept. '52	2,661	2,587	294	1,117	6,659	2,267	8,926

*Supply includes receipts from refineries as well as current production from natural gasoline and cycling plants. Receipts from refineries in December included 175,000 bbls. of natural gasoline and 2,000 bbls. of naphtha.

**Demand does not include liquefied refinery gases produced for fuel and chemical purposes, which totaled 2,855,000 bbls. in December.

†Includes naphtha and other products.

Fig. 9—Makeup of U.S. Motor Fuel Supply


J F M A M 1951 A S O N D
J F M A M 1952 A S O N D
TOTAL MOTOR FUEL SUPPLY
OTHER GAS LIQUID MATERIALS
NATURAL GASOLINE BLENDED
GASOLINE AND NAPTHA FROM CRUDE
U.S. BUREAU OF MINES DATA
MILLIONS OF BBLS DAILY AVERAGE

(Figures in table in 1000 bbls./day average)

	Gasoline & Naphtha from Crude	Natural Blended	Other Gas Liquid Materials	Total Motor Fuel Supply
Dec. '52*	3,067	310	100	3,477
Nov. '52	3,105	311	80	3,496
Oct. '52	2,986	315	82	3,383
Dec. '51	2,864	285	78	3,227

*Estimated from API figures

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Each advertiser listed in this index has been assigned a code letter for use by the reader in securing additional information about advertised products or services which interest him. This code letter appears in parentheses to the left of the advertiser's name.

●

Circle the code letter on the "Advertised Product Inquiry" card (on the page opposite) which corresponds to that assigned the advertiser about whose product you want further information.

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(A-2) AIR PRODUCTS, INC. 388
(A-3) AIRETOOL MFG. CO. 405

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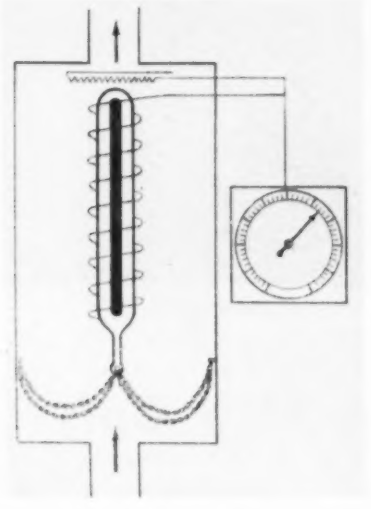
WHAT'S NEW...



Liquid Density Is Continuously Indicated, Recorded, Controlled

. . . in the new "Princo Densitrol," with automatic compensation for temperature. Any calibration can be furnished within limits of 0.2 to 0.005 density, or equivalent full scale range within the limits 0.5 to 3.5 density or equivalent. Accuracy for all ranges is ±3% of range or 0.0002 density, whichever is greater. Sensitivity for all ranges is ±0.5% of range. Sensing element is a totally-submerged plummet, fastened by chain of known weight to a fixed reference point (see sketch). For each density within the range of this plummet-chain assembly, the plummet assumes a definite equilibrium position. Changes in plummet position (therefore changes in sample density) are translated through plummet core and electrical position measuring device into indication, recording or control. Plummet action is without friction or vibration effects. Construction materials permit use at operating temperatures up to 350° C. Models are also available for operating pressures up to 600 psi. Precision Thermometer & Instrument Co., Dept. 7, 1434 Brandywine St., Philadelphia 30, Penna.

Circle No. **1** *on Reply Card*

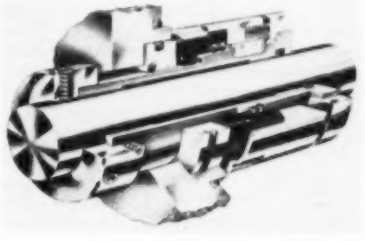
For More Information

Use one of the attached reply cards to request additional details or literature on any items reviewed in "What's New!" Just circle the numbers corresponding to the numbers at the end of each item in which you are interested. Then fill in the rest of the card and drop it in the mail. No postage required.

New Gasoline Additive Protects Engines from Sludge and Gum

. . . by retarding or preventing deterioration of organic substances by atmospheric oxygen. "Impruvol 33" is a 33-1/3 wt.-% solution of ditertiary-butyl-para-cresol in toluene. The cresol (DBPC) is a crystalline, tri-alkylated phenol, now widely used as an anti-oxidant for turbine lube oil and transformer insulating oil, for waxes and vegetable oils, and for rubber. The manufacturer states the Impruvol 33 can be added early in the refining process without loss in subsequent operations. Also, its anti-oxidation property is not greatly reduced by contact with metals in gasoline storage and fuel injection systems. Tests have shown that the product provides good stabilization of aviation gasolines and of TEL fluids. The DBPC can be purchased, if desired, in a flaked form instead of in the toluene solution. Koppers Co., Inc., Pittsburgh 19, Pa.

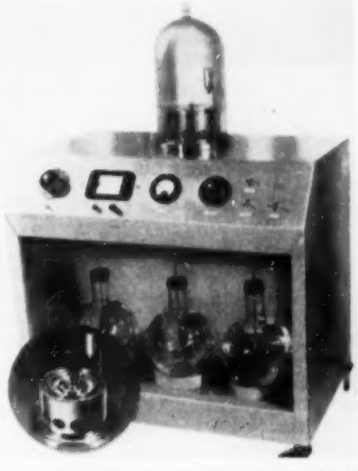
Circle No. **2** *on Reply Card*



Heavy Duty Mechanical Seal Withstands 1000 psi Pressure

. . . and is furnished pre-assembled on a sleeve for ready installation. When used with split case pumps, it is not necessary to lift the upper half of the casing to install or remove the new Type 8-B Shaft Seal. Incorporating a rotating sealing washer and a "floating" stationary seat, balance is accomplished by lowering the washer face to a point where stuffing box pressure is not exerted against the sealing area. Mating faces of the washer and seat are precision-lapped to 0.0000232 in. The rotating assembly comprises a retainer positively driven by the sleeve, with the washer driven from dents in the retainer. The assembly is held in contact with the lapped face of the seat by multiple springs equally spaced around the sleeve at the back of the retainer. "O" rings provide sealing between sleeve and shaft and also between washer and sleeve. Another "O" ring is used between the stationary seat and end plate to prevent stresses on the highly lapped seat face. Crane Packing Co., Dept. P-12, 1800 West Cuyler Ave., Chicago 13, Ill.

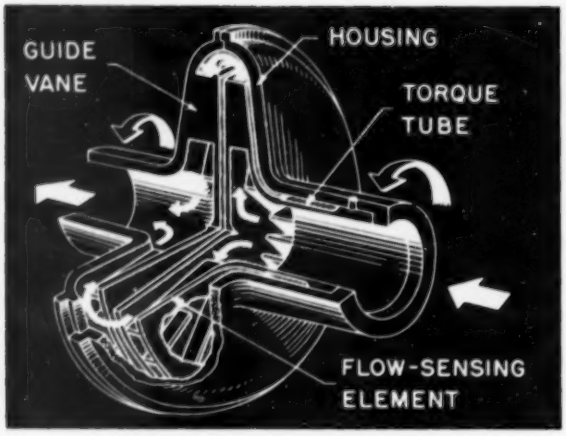
Circle No. **3** *on Reply Card*

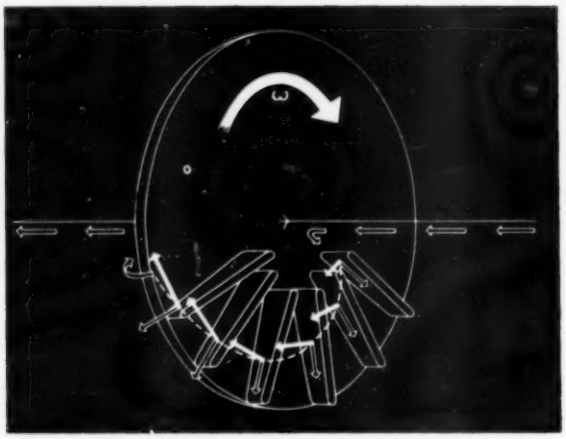


New Cyclic Type Molecular Still Will Operate at High Vacuum

. . . without damage to molecular structure. Normal field of distillation is among materials with molecular weights above 250, except for materials of extreme heat sensitivity such as some of the vinyl polymers. Either a concentrated residue or a derived distillate may be obtained. Preliminary passes can be made to remove water, air, and high or low boiling point fractions. Operation is simple and easily controlled. Junior personnel can fractionate successfully after a few hours of observation and instruction. Evaporation plate is 7 in. in diameter and made of aluminum, but other materials can be supplied. Pumping system consists of a "Cenco-Pressovac" mechanical pump and a diffusion pump with a capacity of 10 liters/sec. Range of the temperature indicating thermocouple is 0-300° C. Vacuum gage is of the thermocouple type with a range of 0-1000 microns Hg. Flasks are 12,000 ml. Pyrex. Heat input is 0-135 volts, variable. Electrical requirements are 110-120 volts 60 cycles, singe-phase, 1200 watts. Cabinet is 16-ga. steel, 24 x 40 x 36 in. high with height overall of 54½ in. Shipping weight is 185 lb. without the pump. Pump is made for and sold by American Instrument Co., Inc., Silver Spring, Md.

Circle No. **4** *on Reply Card*





NEW MASS FLOWMETER; cutaway of primary element at left, principle of operation at the right

New Device Measures Weight Flow Only

A BASIC new development in the field of measurement and control, a new instrument has been designed which will measure weight flow rate in lb/min., yet is totally insensitive to any other factors such as volume, temperature, pressure, viscosity, compressibility, or external accelerations.

To the process man this means no more difficult control problems just to get a flow measurement: he can do away with temperature-compensated instruments. Transients in the system are automatically accounted for. In processes where solids are carried in a fluid stream, such as in catalytic cracking, the total mass rate of flow is indicated simply and directly.

Basically, the mass rate of flow is measured by determining the moment necessary to give the mass a Coriolis acceleration. Referring to the cutaway drawing (above, left), it will be noted that the fluid stream is forced out radially by its own velocity. Referring to the sketch at the right, it will be noted that the path of a given particle is a spiral, because the sensing element and flowmeter case is rotating. Thus the particle now has an increasing tangential velocity (solid vectors) which has been imparted to it by the flowmeter.

To obtain this velocity change, the mass of the particle had to be accelerated; in short, a force was acting on the mass to produce a so-called Coriolis acceleration. The reaction to the force was exerted on the vane of the sensing element which formed a torque about the axis of rotation and served to twist the torque tube.

The measurement to be made then is the amount of twist in the torque tube, or the phase shift between the sensing element and the rotating case.

It is interesting to note that the moment required to produce the Coriolis acceleration is recovered in the vanes attached to the case during the return of the mass particle to the exit pipe. The motor driving the flowmeter need only supply the bearing and seal friction and the windage.

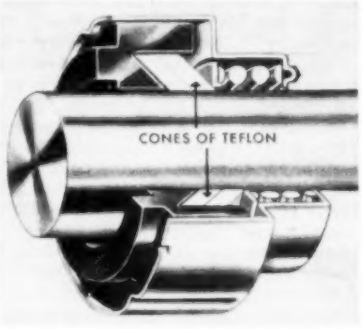
Since the sensing element rotates at the same speed as the case, there are no shear forces dues to viscosity involved. Further, the force produced is the product of the mass and the acceleration, so that pressure or temperature have no effect.

The illustration shows only one of many mechanical forms this instrument can assume. Perhaps the simplest would be a curved tube rotating about a vertical axis which would allow the material to flow out radially, be discharged from the tube, and caught in a bin. With a vertical feed, any material that would fall through a pipe could be weighed, for example catalyst falling through a duct, or grain being transferred from an elevator into a freight car.

The new mass flowmeter will work on multiphase fluids, such as mists, foams, slurries, and emulsions, as well as homogeneous fluids. It will read flow in either direction, and the output reverses when the flow reverses. Its speed of response is sufficiently high to permit accurate measurements on very rapidly changing flows. It will measure accurately the average values of pulsating flows.

Invented by Dr. Y. T. Li, Massachusetts Institute of Technology, the instrument will be made available as rapidly as standards can be developed concerning sizes, flow rates, and types of materials to be handled. However, the manufacturer will first meet the most vital industrial and military needs first. Control Engrg. Corp., Norwood 209, Mass.

Circle No. **5** *on Reply Card*



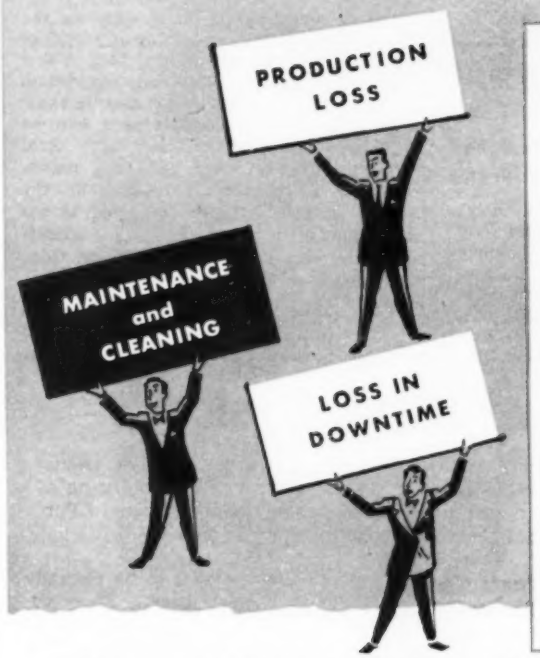
New All Purpose Shaft Seal Provides Long Service Life

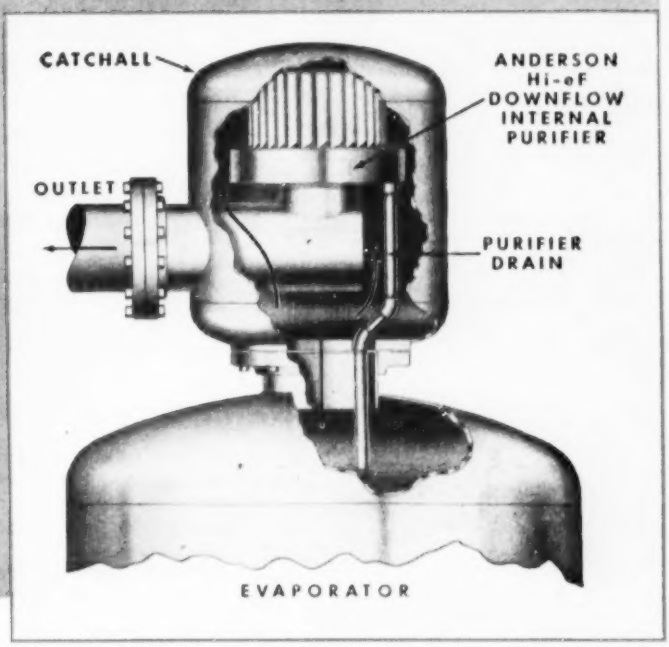
. . . on rotary shaft applications. The "John Crane" Type 19 is said to be designed for small pumps, hot water circulators, and the like. Special beveled cones made of Teflon are utilized as the flexible member. This adapts the seal for services involving water, oil, corrosives or acids; temperatures from −100 to +450° F.; vacuums and pressures to 200 psi.; and high shaft speeds. Type 19 seals are available in sizes for shaft diameters of ¼, ⅜, ½, ⅝, and ¾ in. The metallurgy of the seal, bronze, stainless steel, etc., can be specified to meet service requirements or operating conditions. Crane Packing Co., 1800 Cuyler Ave., Chicago 13, Ill.

Circle No. **6** *on Reply Card*

STOP Entrainment losses in Evaporators Stills and Towers

with ANDERSON Hi-eF PURIFIERS

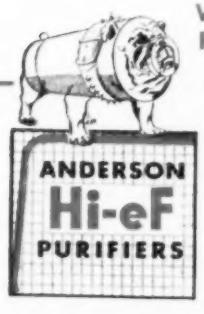




• Evaporators, stills, towers and similar vessels in your plant should have Hi-eF Purifiers. These money-saving units intercept and return to the evaporator all carryover thereby preventing possibility of loss of your valuable products. In addition, by removing this carryover and entrainment, a Hi-eF Purifier eliminates frequent cleaning of vapor lines, condenser tubes and other equipment. A Hi-eF Purifier pays you a rich profit by increasing the time intervals between cleaning and reducing downtime on these units.

Hi-eF Purifiers are the most economical protection you can buy . . . they cost no more than ordinary separators with lower efficiency . . . *yet are guaranteed 99% efficient in entrainment removal!* These carefully engineered purifiers pay for themselves over and over again . . . remove all carryover, solid particles, mist and moisture through carefully guided centrifugal action. Without moving parts or filters, Hi-eF Purifiers require no maintenance . . . have nothing to wear out or replace. Once installed they save you money day after day without any attention whatsoever. Let our engineering staff with many years experience recommend without obligation the proper solution to your current problem. Mail coupon for data.

WATCHDOGS OF STEAM • AIR • GAS • VAPOR PIPELINES AND EQUIPMENT



UPFLOW INTERNAL PURIFIER

LARGE LINE TYPE PURIFIER

DOWNFLOW INTERNAL PURIFIER

RECEIVER TYPE PURIFIER

THE V. D. **ANDERSON** COMPANY

1974 West 96th Street • Cleveland 2, Ohio

Please send information on the following type of purifiers:

☐ Line Type ☐ Internal Upflow ☐ Internal Downflow ☐ Receiver

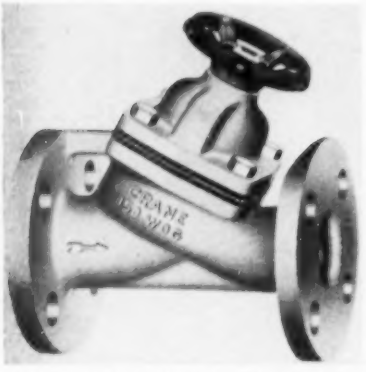
Name ..... Title .....

Address .....

City .....

State .....

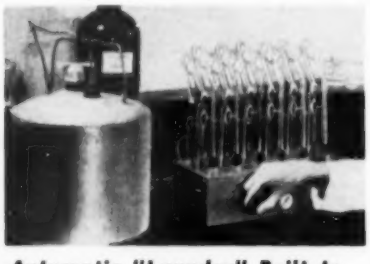
BY THE MAKERS OF SUPER-SILVERTOP STEAM TRAPS



New Materials Being Used in Packless Diaphragm Valve Line

. . . for body, diaphragm, and lining. Now regularly available are bodies and disc holders of cast iron, brass, aluminum, or 18-8 Mo; and diaphragms and disc inserts of Neoprene, Buna-N, and soft natural hard rubber linings. Specially prepared valves are also now regularly available for vacuum, oxygen, and acetylene service. The valves feature a separate diaphragm and disc construction. Since the diaphragm is not used for seating, it is not subjected to the cutting, crushing, and abrasion that lead to rapid wear. Closure of the independent disc will prevent escape of line fluids even if the diaphragm should fail. Crane Co., 836 So. Michigan Ave., Chicago 5, Ill.

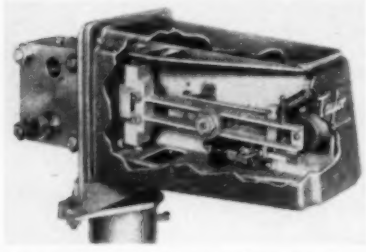
Circle No. **7** *on Reply Card*



Automatic "Laundry" Built to Clean Kinematic Viscometers

. . . or other intricate and delicate laboratory glassware. Designed by E. L. Ruh of Standard Oil Development Co. laboratories, their operation is to spray with solvent and then dry with air. Used viscometers are placed over the machine's vertical capillary tubes. Each tube sprays the solvent into the viscometer at a pre-set pressure. Depressing a knob starts the spray; releasing it stops the spray and substitutes an air blast to evaporate the solvent. A pressure regulator controls spray pressure to within limits, producing when desired a "spurt" action effective in flushing out an oil coating the tube interior. Solvent, held in a 5-gal. pressure tank, is forced through the capillaries with compressed air from a cylinder or the laboratory supply line. The unit is available with or without solvent tank. Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Penna.

Circle No. **8** *on Reply Card*



New Transmitter Is Designed For Close-coupled Measurement

. . . of fluid flow, liquid level, or any others where differential pressure is required. A force-balance instrument, it converts differential pressure into an equivalent 3 to 15 psi. output. The "Transaire" transmitter has two basic units. The primary senses differential pressure and consists of a two-part, forged steel or stainless steel housing enclosing a Teflon - coated, glass - fabric diaphragm. Its inner housing is shaped to the contour of the diaphragm to permit full over-range protection of 1500 psi. to either side of the diaphragm. The secondary unit transmits the proportional output air pressure and incorporates a ruggedly constructed, pneumatic force-balance transmitting system. Two ½-in. pressure taps are located on both the high and low pressure sides so the unit is fully adaptable for any kind of service. Compact design, 14½ x 6 x 7¾ in., permits close coupling, which means shorter lead lines and, in most cases, fluid to be measured can be introduced into the meter body. Seal and purge systems are only necessary to prevent corrosion in the transmitter. Range changing is accomplished with the range adjustment slide. Taylor Instrument Cos., Rochester 1, N. Y.

Circle No. **9** *on Reply Card*

DID YOU MISS THESE?

The following items, reviewed originally in the January issue, have aroused considerable interest. They are repeated briefly as a service to those who might have missed them the first time. For details or literature, use the regular Reply Card in this issue.

Dissolved Oxygen Contents Can Be Obtained in 10-30 Seconds

. . . with the new Dorber Portable Analyzer for aqueous solutions. Tests are not subject to interference by dissolved iron, calcium, magnesium, or organic matter. Unit is said to be suited for field use in checking the oxygen content of sewage or brines, or in the laboratory on chemical processes. It uses an amperometric principle in which minute traces of dissolved oxygen are reduced at a rotating platinum cathode. The electrode assembly is on a detachable frame that can be used for other analyses if desired. Determinations correct to 5% with most solutions can be made in 10 to 30 seconds. Dorber Co., 7741 West Palatine Ave., Chicago 31, Ill.

Circle No. **10** *on Reply Card*

New Electric Process Developed For Treating Distillate Stocks

. . . with acid, alkali, doctor, or similar chemicals. It is designed for continuous, automatically-controlled operations. Relatively small ground space is required: the treater usually is not larger than 10 ft. in diameter. Extra equipment such as pumps, tanks, filters, centrifuges, and the like, are said to be virtually eliminated in many cases. The process can be applied to such stocks as naphtha, gasoline, kerosine, cat-cracker charge, cat-cycle oils, diesel fuel, and furnace oil. Electrical requirements are within the normal capacity of the usual refinery power supply. Petrolite Corp., Petreco Div., 5515 Telegraph Rd., Los Angeles 22, Calif.

Circle No. **11** *on Reply Card*

Southwest Research Institute

. . . and its activities are described in its 5th Annual Report, 5 *Years & The Future*; including projects in industrial waste disposal, gum formation problems in natural gasoline plant absorber oil, fuels, lubricants, engine research, etc. Southwest Research Institute, 8500 Culebra Rd., San Antonio, Texas.

Circle No. **12** *on Reply Card*

The Importance of Emptiness

. . . is the subject of a 12-page booklet, *Vacuum—the Magic Hat of Industry*, written in non-technical language about the uses of vacuum and methods of producing it. Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

Circle No. **13** *on Reply Card*

A Superior Controller

must be readily adaptable

FIELD MOUNTED
THE FLEXIBILITY OF THE CONTROLLER TYPIFIES
P-4 PNEUMATROL

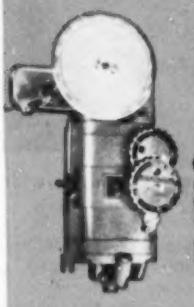
The "building block" design and construction of Fischer & Porter P-4 Pneumatrol units provides the maximum in versatility of use. These design features permit ready change of a case mounted Pneumatrol into a field mounted controller by the mere addition of pre-built, basic elements. This unique feature of the P-4 assures minimum spare parts inventory and simplifies servicing.

The P-485 field mounted controller combines the best features of force and motion balance controllers by the unique application of paired bellows elements for precision, speed and permanence. It is the fastest field mounted controller and yet has completely stable high frequency response. P-4 Pneumatrol units are extremely compact in size, simple in operation and completely corrosion resistant.

The plug-in type companion manifold has been just as thoroughly designed as the P-4 and includes built-in cut-off relay, automatic output cut-off below 1 psi setting pressure, positive self-sealing ports with unusually large air passages to prevent degrading the control response.

F&P P-4 Pneumatrol flow controllers are extremely versatile in their application. Complete information is yours for the asking. Write today!

P-485 FIELD MOUNTED CONTROLLER
(Proportional, Reset, Derivative) with plug-in air connections. Mounting plate includes shutoff relay and air check valves.



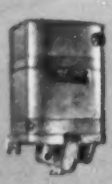
P-475 FLOW RATIO CONTROLLER
for wide range flow ratio requirements. Optional construction provides VARIABLE PNEUMATIC SET CONTROL.

P-45 CASE MOUNTED CONTROLLER
Proportional, Automatic Reset. Derivative Action obtained by installing snap-in resistor assembly below proportional dial.

P-43M CASE MOUNTED CONTROLLER
Wide band proportional with manual reset.

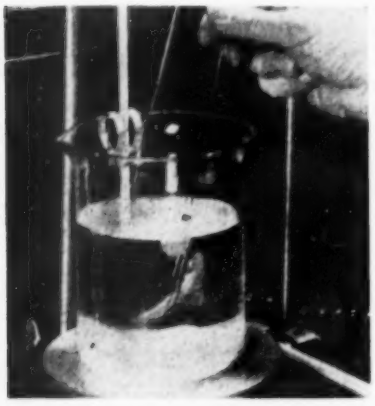
P-42 CASE MOUNTED CONTROLLER
Narrow band proportional.

P-41 CASE MOUNTED CONTROLLER
On-off action.



Temperature compensated precise pneumatic transmitter—a special form of the P-4 Pneumatrol utilizing many features.

FISCHER & PORTER CO.
1130 County Line Road, Hatboro, Penna.



Stop Thermometer Breaks with Handy Stainless Steel Clamp

. . . that fits over the rim of the beaker. Have you ever placed a valuable thermometer in a valuable sample, put a flame under the beaker, and then returned to find the thermometer broken, a hole in the beaker, and the sample on the bench top? The new "Thermo-Clamp" is designed to lick this problem by holding any thermometer upright against the side of the beaker, even when the solution "bumps." An inch in diameter, ¾ in. wide, the clamp has just enough tension to hold a thermometer firmly without damaging it. It can also be used, if desired, to hold glass stirring rods or metal electrodes. Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Penna.

Circle No. **14** *on Reply Card*

Centering Head Is Described As Five Pipe Tools in One

. . . package, replacing protractor, centerhead, center punch, level, and scale in the tool chest. A pocket-size device with dial set leveling gage, it can be used to mark a point at any degree from pipe center or on other round objects. It will measure or establish the degree of any angle or of the bend on the outside or inside of any circumference; measure the degree of declivity of any flat surface, etc. It simplifies laying out keyways, manifolds, bell-ends or butt-ins. Its two-pronged, cast aluminum body has a 1¾-in. sheet aluminum protractor dial, graduated in 2½ degrees. The marking punch is ¾-in. drill rod with a hardened point. Contour Marker Corp., 1843 Compton Blvd., Compton, Calif.

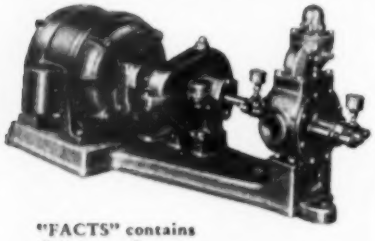
Circle No. **15** *on Reply Card*

Rigid Vinyl Plastic Pipe Holds Up under 500 psi. and 77° F.

. . . operating conditions. "Kraloy D-500" is furnished in ½ to 4-in. sizes with all necessary molded fittings. At ordinary pressures it can be used satisfactorily for many chemicals, including oxidizing agents, at temperatures up to 190° F. It has a tensile strength of 10,000 psi., is heat resistant and will not support combustion. Outdoors, it is unaffected by weather and sunlight. Available from several nationally-known distributors, it is made by Kraloy Plastic Pipe Co., Inc., 4710 East Washington Blvd., Los Angeles 22, Calif.

Circle No. **16** *on Reply Card*

BLACKMER
Self-Adjusting for Wear
ROTARY PUMPS
for Liquid Materials Handling . . . Petro-chemicals
FROM HEXANE TO TAR



"FACTS" contains design and construction, maintenance, operation and application data for better pump service.

WRITE FOR YOUR COPY

BLACKMER PUMP CO.
GRAND RAPIDS, MICH.

THIS MICRO-PRESSURE ELECTRONIC MANOMETER-FLOWMETER MEASURES

- pressure differences as small as 1/1,000,000 psi
- slightest gas flow with practically no pressure drop

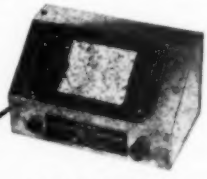
A new type manometer for critical applications and micro pressures. Highly sensitive, stable, yet lower in cost than less accurate instruments. Gauge tube can be mounted in a bypass outside pipe orifice, producing negligible pressure drop.

Compact low-temperature noble metal gauge tube is unaffected by high pressures. Meter sensitivity remains constant, regardless of lead length.

Dual range logarithmic type scales read directly from 0.001" to 0.1", and 0.1" to 2" water without recalibration between ranges. Response time, less than ½ second.

This instrument can be used for master station monitoring or with a direct recording unit.

Write for descriptive literature and prices.



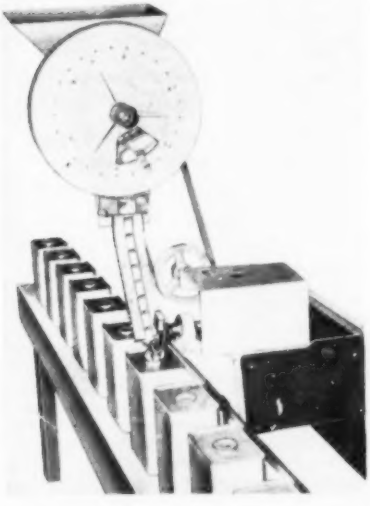
HASTINGS INSTRUMENT COMPANY, INC.
HAMPTON 36, VIRGINIA
DESIGNERS AND BUILDERS OF RAYDIST AND SPECIAL ELECTRONIC, ELECTRICAL, AND MECHANICAL INSTRUMENTS

What's New!

Automatic Refining Is Feasible With New Electronic Computer

. . . with high operating speed (60 micro-seconds per unit of addition). The "ERA 1103" is a general purpose digital system, providing storage capacity up to 17,408 superspeed registers, plus unlimited supplementary magnetic tape bulk storage, and wide programming versatility. First commercial models will be available for delivery in 1954. Manufacturer states it will make it possible to apply automatic processing to a large oil refinery or a chemical plant. The machine will receive data on the processing through sensing devices at various stages in the operation. These data would be processed in the computer according to instructions fed in previously. If desired, it can receive data based on the analysis of the crude being processed and, in turn, regulate the process in such a way that the refinery will manufacture the highest dollar volume obtainable. An example of the instrument's speed is its ability to add, in one second, 17,600 10-digit numbers. The complete system occupies an area slightly smaller than the ground floor of an average house. It weighs about 10 tons. The electronic system with 4500 tubes, is said to operate on less power than four double-oven electric ranges. Remington Rand Inc., 315 Fourth Ave., New York 10, N. Y.

Circle No. **17** *on Reply Card*



Rotating Magnetic Head Makes Lid Sealing Fully Automatic

. . . by being timed with the continuous movement of containers on a chain conveyor. Metal seals, inner seals, and friction lids can be applied to any position on tin and fiber cans. In operation, lids flow from a hopper through a chute, where

These popular extra-handy

RIDGID

drop head dies

give you clean threads fast and easily

★ Small, well balanced, clean cutting, these popular RIDGID ratchet threaders are a pleasure to work with. They save you time and effort because heads snap into drive ring from either side, won't fall out. Precision-cut alloy dies reverse for close-to-wall threads—no special dies needed.

★ 00R and 0R, ⅛" to 1"; 111R and 11R, ⅛" to 1¼"; 12R, ⅛" to 2". Conduit dies, too—and free carrier with sets. Buy them at your Supply House.

THE RIDGE TOOL COMPANY • ELYRIA, OHIO

RIDGID

Work-Saver Pipe Tools

(To obtain more data on advertised products see page 424)

for SAFE—
Temperature Control

The Burling Pneumatic Control is a MUST in the processing of Petroleum. It may be used as a primary control or as a high temperature safety cut-out on existing control equipment.

Any standard pneumatic control pressure up to 50 psi can be used for operating a diaphragm type valve or motor. It is suitable for temperatures from sub-zero to plus 1800° F.

BURLING
Instrument Company
4 Vose Ave. South Orange, N. J.

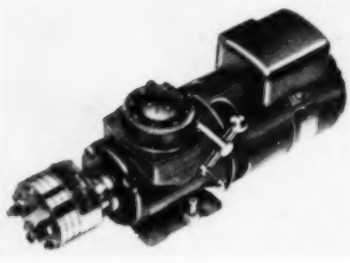
Temperature Controls since 1935

THE RELIABLE ELECTRONIC MEMORY
MAGNETIC DRUM STORAGE SYSTEMS
for DIGITAL COMPUTERS
INPUT
STORAGE
CONTROL
ARITHMETIC
OUTPUT
AUTOMATIC PROCESS CONTROL SYSTEMS
or other HIGH-SPEED DATA HANDLING REQUIREMENTS
Investigate these advantages
• Proven dependability
• Large storage capacity
• Alterable yet non-volatile storage
• High speed
Write for this brochure
Engineering Research Associates
Division of Remington Rand
1902 West Minnehaha Avenue, Dept. P-2 • St. Paul W4, Minnesota
DIGITAL COMPUTERS • DATA HANDLING SYSTEMS • MAGNETIC STORAGE SYSTEMS • INSTRUMENTS • ANALOG MAGNETIC RECORDING SYSTEMS • COMPUTING SERVICE

What's New!

magnetic fingers pick them up and place them on the containers passing along below. No supplemental operation is necessary for finishing off with a more positive seal. Containers do not stop momentarily, thus there is no danger of splashing or spillage. Machine is fully adjustable for variations in position, can size, etc. Tite-Cap Machine Co., Inc., Rose St., New York 38, N. Y.

Circle No. **18** *on Reply Card*



Controlled Volume Pumps Have Capacity Range of 0-3.6 gpm.

. . . with continuous, non-pulsating flow. Starts and stops are instantaneous with the motor, and a check valve prevents dripping. Output of the variable speed units is adjustable while pump is in operation. The line of pumps can handle hot or cold, viscous or non-viscous liquids, such as oils, fats, grease, wax, and numerous chemicals and compounds. The "Maisch" Metering Pumps resist the corrosion and chemical action of most liquids. An external seal for the drive shaft prevents contamination within the pump from outside sources. Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.

Circle No. **19** *on Reply Card*

Trade Literature

Acetylene from Hydrocarbons

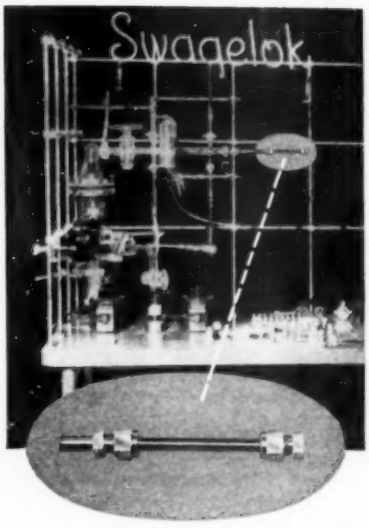
. . . by the Wulff Process, 24-page report with process description and simplified flow diagram, plus data on plant and manufacturing costs. The Lummus Co., Room 359, 385 Madison Ave., New York 17, N. Y.

Circle No. **20** *on Reply Card*

Temperature Measurement

. . . principles, basic types of control systems and their evaluation is covered in *The Design and Process Engineers Guide to Industrial Temperature Measurement and Control*, discussing eight ways of responding to temperature; five ways of putting that response to work; and nine instrument types of the manufacturer. The Partlow Corp., New Hartford, N. Y.

Circle No. **21** *on Reply Card*



0.0000000194 PSIA

STANDARD

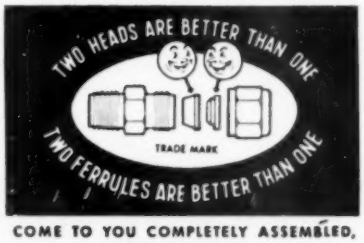
Swagelok®

TUBE FITTINGS HOLD ULTRA-HIGH VACUUMS

Swagelok tube fittings, by providing a vacuum-tight mechanical seal, have now extended ultra-high vacuums beyond the laboratory into industrial applications. The Swagelok Ultra-High Vacuum Demonstrator above incorporates standard Swagelok fittings—a reducer and a cap. It demonstrates that the air pressure in the system can be reduced repeatedly from the normal 14.7 pounds per square inch absolute to 0.0000000194 psia. For information on Swagelok fittings and ultra-high vacuum test data address Dept. 65.

CRAWFORD FITTING CO.
884 E. 140th Street, Cleveland 10, Ohio

SWAGELOK FITTINGS AVAILABLE IN: BRASS, ALUMINUM, STEEL, STAINLESS STEEL, MONEL



COME TO YOU COMPLETELY ASSEMBLED, FINGER TIGHT

PALMER

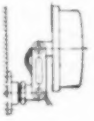
MERCURY ACTUATED

Dial Thermometers now in three types to suit any requirements

Full 4½" dial face. Stem can be placed at any angle and case can be rotated to any readable position.

1 **Rigid Stem Dial Thermometer** tapered bulb, interchangeable with standard industrial thermometer separable socket. (As illustrated above.)

2 **Wall Mounted Dial Thermometer** with flexible connecting armor. Case adjustable to easy reading position.



3 **Flush Mounted Dial Thermometer** for panel mounting with flexible connecting armor.

All three types have a full 4½" dial face.

for accuracy: Mercury actuated . . . Fully Compensated by Invar Compensaton. Guaranteed Accurate 1 scale division.

for angularity: Can be adjusted to most readable position at any angle desired.

for readability: Bold Black Numbers . . . 11" of scale Reading Dial face can always be placed in easiest readable position.

for interchangeability: Always specify "PALMER" Separable sockets as they are interchangeable for Dial or Industrial type Thermometers.

Send for Bulletin 51-129 for details on the New Palmer Dial Thermometer.

PALMER

THERMOMETERS, INC.

Norwood Ave., Cincinnati 12, Ohio

Mfrs. of Industrial Laboratory Recording and Dial Thermometers

What's New!

Ultrasonic Homogenizing

. . . in a machine based on the principle of the Puhlmann Whistle, in which vibrations are effected by a jet of liquid impinging on a blade which vibrates at its natural frequency, both jet form and blade being enclosed by a resonant bell which concentrates the local ultrasonic effect. The "Rapisonic" machine is described in new booklet *You're Ahead Five Jumps.* American Ultrasonics Co., 198 Pacific St., Newark, N. J.

Circle No. **22** *on Reply Card*

Instrument Charts

. . . and how they are made. New booklet tells *There's Plenty behind a Technical Chart.* Technical Charts Inc., Buffalo 10, N. Y.

Circle No. **23** *on Reply Card*

Mechanical Shaft Seal

. . . reference booklet and catalog, with detailed specifications, cutaway views, recommended uses; for wide range of temperature and pressure conditions and wide variety of fluids. Durametallic Corp., 2104 Factory St., Kalamazoo 24F, Mich.

Circle No. **24** *on Reply Card*

Insulated Pipe Test

. . . report on simulated operations, temperatures developed in and near the pipe buried 48 in. underground, and effects of water and high temperature on the molded asbestos casing. Copies of the six-page summary, with detailed tables available from Durant Insulated Pipe Co., Palo Alto, Calif., or from Durant International Corp., Williamstown, N. J.

Circle No. **25** *on Reply Card*

Separator-Dehydrator

. . . combination, in three stages, with a four-stage 5-micron filter; described in new Excel-so *Bulletin FEQ-51*; units have capacities from 5 to 2000 gpm. Warner Lewis Co., Box 3096, Tulsa 8, Okla.

Circle No. **26** *on Reply Card*

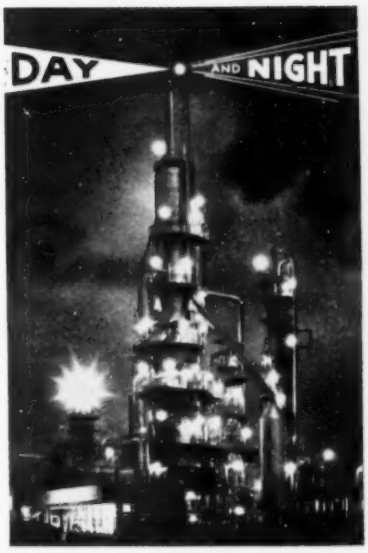
Steam Jacketed Fittings

. . . and pipe for use on welded piping. General catalog includes complete information on this new line as well as standard line of fittings and pipe for flanged end use. Red Jacket Co., Investment Bldg., Pittsburgh 22, Penna.

Circle No. **27** *on Reply Card*

Synthetic Organic Chemicals

. . . production estimates for 1955 and 1975; figures in a booklet form assembled from the five-volume report of the Materials Policy Commission: includes 18 tables on such products as coal tar crudes, benzene, napth-



Night and day the clock around, week after week, month after month, NATIONAL AIROIL Tandem Combustion Units ceaselessly assure "continuous operation" for petroleum heaters in refineries throughout the Nation and the world. YOU will realize higher profits from YOUR oil heaters when Tandem Combustion Units are specified.

NATIONAL AIROIL has a complete line of Oil and Gas Burners and Furnace Equipment for every requirement.

Chem-Petroleum Div.

NATIONAL AIROIL BURNER COMPANY, INC.

1297 Sedgley Ave., Philadelphia 34, Pa. Southwestern Division: 3512 So. Blvd., Houston 6, Tex.

COMPLETE COMPUTING SERVICE

for • Problem Analysis
• Programming
• Machine Computation

in the fields of applied science, technology, and large-scale data processing.

Offered to industry . . . to government agencies . . . and to research organizations. This center will operate an ERA 1101 . . . a large-scale general-purpose digital computer with an outstanding record of reliable performance.

We Invite Your Inquiry.

For additional information on facilities and services of the ERA Computation Center write DEPT. P-2

Engineering Research Associates

Division of Remington Rand

COMPUTATION CENTER, 555 23rd Street So., Arlington, Virginia

(To obtain more data on advertised products see page 424*)*

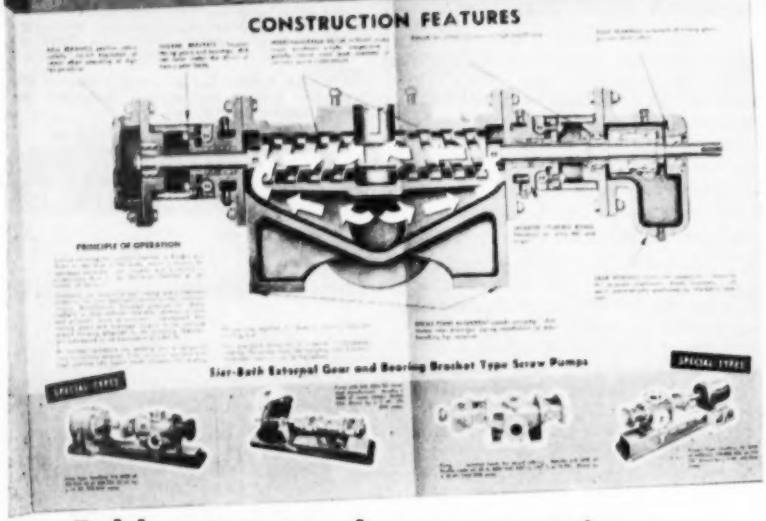
PUMP *Non-Lubricating* MATERIALS?

Send for this

NEW BULLETIN (SE-5)

illustrating, describing

Sier-Bath
External Gear & Bearing
Bracket Type
SCREW PUMPS



Fold-out page shows operation... construction details... special types

- pump fuel oils, crude oils, cellulosics, distillates, etc.
- fluids and semi-fluids, 32 SSU to 1,000,000 SSU
- capacities 1-700 GPM
- discharge 1000 PSI for viscous liquids, 500 PSI for water

Sier-Bath "Gearex" and "Hydrex" Gear Pumps for lower pressures and capacities

Recently introduced, this Sier-Bath Pump incorporates all the latest refinements of screw pump design . . . and then some. *Center line support* speeds assembly . . . *single point alignment* eliminates rotor distortion . . . *radial and axial* control of rotors by heavy-duty bearings for sustained efficiency, long life. For the *whole* story . . .

SEND FOR BULLETIN SE-5

Sier-Bath GEAR & PUMP CO., Inc.
9261 Hudson Blvd.
North Bergen, N. J.

Founded 1905 Member A. G. M. A.

Also Manufacturers of Precision Gears and Flexible Gear Couplings

What's New!

alene, cyclic intermediates, cresols and cyesylic acids, phenol, phthalic anhydride, styrene, cyclic end products, ethylene, acetylene, methane, etc. R. S. Aries & Associates, 400 Madison Ave., New York, 17, N. Y.

Circle No. **28** *on Reply Card*

Data Card on Tubing Steel

. . . for elevated temperature and pressure applications. *Bulletin TDC-146* discusses B&W Croloy 5 (4-6% Cr, ½% Moly), and its uses and value in refinery and other process industry applications as furnace tubes, piping, and superheater tubing. Babcock & Wilcox Co., Beaver Falls, Penna.

Circle No. **29** *on Reply Card*

Cast Steel Valve Catalog

. . . covering globe, angle, and check valves in 300, 600, 900, and 1500 psi. classes: 56 pages of standard engineering information needed for valve selection. *Catalog No.* 12-C Edward Valves, Inc., Dept. CS, 1200 West 145th St., East Chicago, Ind.

Circle No. **30** *on Reply Card*

Magnetic Motor Starters

. . . with vertical overloads below contactor, designed specifically for petroleum, chemical, petrochemical and related industries for use in explosion-proof condulets of the Crouse-Hinds M52 Type EPC; 8-page folder. Arrow-Hart & Hegeman Electric Co., 103 Hawthorn St., Hartford 6, Conn.

Circle No. **31** *on Reply Card*

Extra Low Carbon Stainless

. . . steels are explained in a new booklet covering the following grades 18-8 ELC (Type 304 L) and 18-12 Mo ELC (Type 316 L); including tables on chemical analysis and typical mechanical properties: these steels being developed to solve the problem of carbide precipitation alongside weld areas with attending intergranular corrosion. Armco Steel Corp., Middletown, Ohio.

Circle No. **32** *on Reply Card*

High-Surface Sodium

. . . its preparation, properties, and applications, including refining of petroleum hydrocarbons. A 20-page working manual on colloidal sodium adsorbed on inert solids of high-surface area. U. S. Industrial Chemicals Co., 120 Broadway, New York 5, N. Y.

Circle No. **33** *on Reply Card*

Help on Engineer Recruitment

. . . problems is offered in a 24-page booklet *How Your Company Can Help Promote Engineering as a Career*, being offered by The Advertising Council, Inc., 25 West 45th St., New York 36, N. Y.

Circle No. **34** *on Reply Card*

What's New!

Petroleum Processing Index

. . . for the year 1952. It includes subject and author indexes for all feature articles and regular departments for the 12 issues of this magazine published during the past year. Platt's Petroleum Publications, 1213 West Third St., Cleveland 13, Ohio.

Circle No. **35** *on Reply Card*

Insulation Data Charts

. . . explaining the degree of protection from condensation afforded by Insul-Mastic Type "D". Charts show percent relative humidity above which moisture will condense on surface of equipment or pipe not insulated and that coated with Type D, at ¼ and ⅜-in. thicknesses, pipe temperatures from 35 to 95° F. and ambient air from 40 to 100° F. Insul-Mastic Corp. of America, 1141 Oliver Bldg., Pittsburgh 22, Penna.

Circle No. **36** *on Reply Card*

Diaphragm Motor Valves

. . . for narrow band proportional control, single and double seated; *Sheet* 419-2 gives specifications, performance ratings, dimensions, and other data on the Honeywell Series 100. Minneapolis-Honeywell Regulator Co., Station 64, Wayne & Windrim Aves., Philadelphia 44, Penna.

Circle No. **37** *on Reply Card*

Flexible Gear Couplings

. . . built for quick assembly or disassembly with no special tools; typical application, standard and special types, and engineering data in new Catalog C 4. Sier-Bath Gear & Pump Co., Inc., 9252 Hudson Blvd., North Bergen, N. J.

Circle No. **38** *on Reply Card*

Trioxane

. . . a crystalline form of formaldehyde, alpha-trioxymethylene; its physical properties, manufacturer's specifications, and suggested uses (including deodorizers, organic syntheses lube oil pour depressors); *New Product Bulletin N*-31-1. Celanese Corp. of America, 180 Madison Ave., New York 16, N. Y.

Circle No. **39** *on Reply Card*

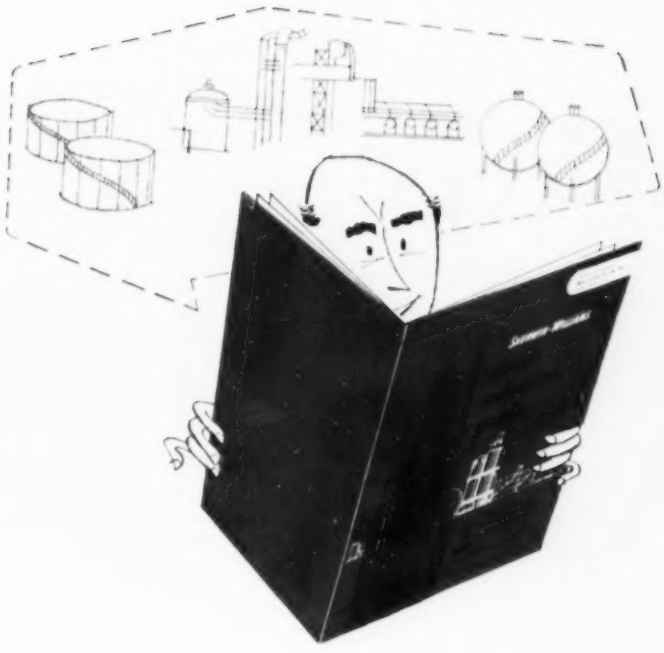
Seal-less Centrifugal Pump

. . . data booklet, including general specifications, performance curves for the present models, and a dimensional outline drawing; in fractional and 1, 2, and 3 hp. sizes. Chempump Corp., 1300 East Mermaid Lane, Philadelphia 18, Penna.

Circle No. **40** *on Reply Card*

Tar Base Protective Coatings

. . described in five bulletins: *Pitt Chem* 101, for severest conditions; *Pitt Chem* 102, for general maintenance on all types of surfaces; *Pitt Chem* 103, for surfaces exposed to cor-



quick answers

to refinery painting problems

new guide tells WHAT paints to use WHERE!

Here's practical, convenient help in selecting the right refinery finishes—for decoration and protection of all types of surfaces, from floors to refractionating towers. It's the most complete book on the subject Sherwin-Williams has ever published.

An important feature is a 6-page check chart, which tells *at a glance* what finishes to use for each refinery structure, for each structural material. The recommendations are based on extensive refinery applications through many years, under all types of operating conditions. Included are suggestions on proper surface preparation, steps to take in painting, what to avoid. It's fitted to your needs, to your methods.

Ask for your copy. Write for Brochure B-770. Or write The Sherwin-Williams Co., Petroleum Division, Cleveland 1, Ohio.

SHERWIN-WILLIAMS

PETROLEUM FINISHES

(*To obtain more data on advertised products see page* 424)

For Eye-Level Readings...

AUTO-LITE

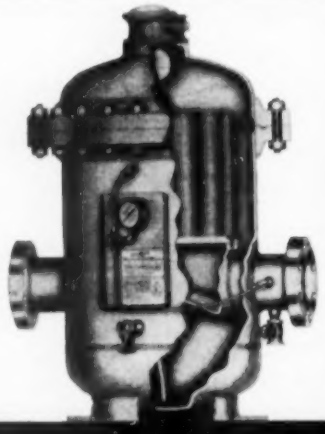
...TEMPERATURE INDICATION

Auto-Lite offers many thermometer styles, permitting plant-wide temperature observation at low cost. Standard temperature ranges from minus 60°F to plus 750°F. Send for latest catalog showing various types.

Model F-1 temperature indicator—Rigid stem or capillary tubing for EYE-LEVEL remote reading. Priced from $22.

THE ELECTRIC AUTO-LITE COMPANY
INSTRUMENT AND GAUGE DIVISION
TOLEDO 1, OHIO
NEW YORK • CHICAGO • SARNIA, ONTARIO

TEMPERATURE INDICATORS & RECORDERS



EXCEL-SO
5 MICRON
FILTERS
for finished
PETROLEUM
PRODUCTS

Designed to remove dirt (down to 5 microns) from finished petroleum products . . . removal of this microscopic rouge lengthens the life of jet and gasoline aircraft engines, pumps, meters, valves, and fittings. They are compact in size and are built for operating pressures from 0-2500 psi. EXCEL-SO Filters can be built to any code requirement, API-ASME, ASME or state codes for unfired pressure vessels. They also meet requirements of JAN or MIL specifications. Available in capacities from 10-2000 G.P.M. Special "Throwaway" Plastic Filter Bundle available on request. Write for Bulletin FO-52.

WARNER LEWIS COMPANY
BOX 3096 • TULSA, OKLAHOMA

What's New!

rosive vapors, dilute acids and alkalies; *Pitt Chem* 104, for water tanks and piping. Pittsburgh Coke & Chemical Co., Room 1953, Grant Bldg., Pittsburgh 19, Penna.

Circle No. **41** *on Reply Card*

Heavy Duty Rotary Pumps

. . . of the herringbone gear type, with capacities to 5000 gpm., pressures to 100 psi.; and the sliding-vane type, with capacities to 1000 gpm., pressures to 200 psi.: Bulletin W-483-B2 covers applications, coverage charts, mountings and dimensions, viscosity conversion table, a viscosity-temperature chart for fuel oils, etc. Worthington Corp., Reciprocating Pump Div., Harrison, N. J.

Circle No. **42** *on Reply Card*

Uses of Persulfates

. . . in organic chemistry, polymerization and depolymerization, among others. *Bulletin No.* 34 consists of a comprehensive bibliography of the literature in this field for the period covering 1907-1950. Buffalo Electro-Chemical Co., Inc., Station B, Buffalo 7, N. Y.

Circle No. **43** *on Reply Card*

Predictable Performance Flow

. . . test kit for laboratory research or field flow checking is described in Catalog 33 *Portable Wide Range Flow Test Kit.* Kit contains five variable area flowmeters with water range from 0.75 to 805 cc/min., air from 50 to 34,500 cc/min., and includes a handbook. Fischer & Porter Co., 745 Jacksonville Rd., Hatboro, Penna.

Circle No. **44** *on Reply Card*

Saran-lined Venturi Nozzle

. . . available in the following Saran-lined steel pipe sizes: 1, 2, 3, 4, 6, 8, 10, and 12 in.; details covered in Bulletin 130-J6. Builders-Providence, Inc., P. O. Box 1342, Providence 1, R. I.

Circle No. **45** *on Reply Card*

Gage Glass Illuminators

. . . using mercury vapor; general data and dimensional drawings, in one-page data sheet 10-15-52. Jerguson Gage & Valve Co., 80 Fellsway, Somerville 45, Mass.

Circle No. **46** *on Reply Card*

Uses for Purifiers

. . . or mechanical separators in petroleum, chemical, and other industries on steam, air, vapor, and gas lines; and on fractionators, reactor overhead lines, and the like. Bulletin 700, *End Dirt and Moisture Problems the Hi-eF Way,* illustrates and describes 14 different applications. V. D. Anderson, Purifier Div., 1935 West 96th St., Cleveland 2, Ohio.

Circle No. **47** *on Reply Card*

What's New!

Propargyl Alcohol

. . . or 2-propyn-1-ol, its properties and its reactions, covered in detail in *GAF New Product Bulletin No. A-103*. General Aniline & Film Corp., 435 Hudson St., New York 14, N. Y.

Circle No. **48** *on Reply Card*

Remote Measurement

. . . and automatic data conversion; applications in power and fuel distribution systems, manufacturing processes, and similar. Ten-page bulletin on radio telemetering research development and consultation services. Applied Science Corp. of Princeton, P.O. Box 44, Princeton, N. J.

Circle No. **49** *on Reply Card*

Maintenance of Clad Steel

. . . equipment is covered in a new illustrated guidebook, *Cleaning and Maintenance of Clad Steel Equipment*, outlining recommended procedures giving solution formulas for cleaning specific kinds of surfaces, etc. Copies can be obtained from fabricators who supply clad steel equipment. Booklet was published by Lukens Steel Co., Coatesville, Pa.

For Your Convenience

Business reply cards are included in each issue of PETROLEUM PROCESSING to assist you in obtaining more information on any items reviewed in "What's New!" You'll find them facing the first page of this section. Just circle the numbers corresponding to the numbers at the end of each item in which you are interested. Then fill in the bottom of the card and drop it in the mail. No postage required.

Information Offered in The Advertisements

Do you need detailed information on a specific subject? Check through this easy-to-use index of literature and data offered in this issue's advertisements:

ADDITIVES, all types, for motor fuels, lube & fuel oils: Information; Monsanto Chemical Co. See adv't p. 311.

AIR CONDITIONING, industrial: Information; Servel, Inc. See adv't p. 323.

AIR PREHEATERS: Full details; The Air Preheater Corp. See adv't p. 351.

ALLOYS, bar stock: Information; Haynes Stellite Co. See adv't p. 392.

CATALYST SUPPORTS, of refractory materials: Bulletin CS-2; Norton Co. See adv't p. 320.

CHEMICALS, sulfur chlorides: Information; Hooker Electrochemical Co. See adv't p. 341.

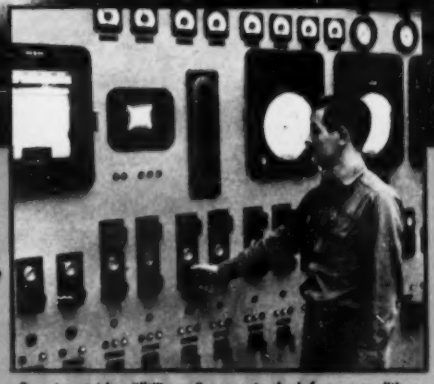
KEEPING CLOSE WATCH ON

A Suburb of Hell

(Above) Inside of boiler furnace with temperatures up to 3000°F as SEEN by the "Utiliscope" camera.

Again

DIAMOND "UTILISCOPE" (WIRED TELEVISION)



Operator watches "Utiliscope" screen to check furnace conditions.

Gives Eyes to Instruments

The interior of a big power boiler . . . white hot with flaming powdered coal or fuel oil . . . can't be looked at conveniently. This "suburb of hell" is too hot and too brilliant for the human eye to watch continuously.

But it needs continuous watching. Only VISION can ride herd perfectly on the varying conditions of the raging flame . . . give a "sense of reality" to the control operator. There are plenty of instruments but they can't see.

At the Port Jefferson Power Station of Long Island Lighting Co., each furnace has a "Utiliscope" that looks directly into the fire. On a viewing screen in the centralized control room, the operator can SEE conditions that help in eliminating smoke. He can SEE that the ignition torches are operating satisfactorily before admitting pulverized coal or fuel oil. He can also SEE when ignition takes place during lighting off. On low load operation, he can SEE the stability of the flame.

Many processes and operations in industry need close observation for safe, accurate, and efficient control. But often they are too remote, too inaccessible, too hot, too cold, too dangerous, etc. for direct eye observation. The "Utiliscope" can watch these things . . . bring the image where it is needed. Write for bulletin containing suggestions.

TYPICAL USES — Studying destructive tests of engines • Watching flow of molten steel • Checking remote gauge readings • Viewing nuclear research Coordinating materials flow on conveyors • The "Utiliscope" (Registered U. S. Patent Office)

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What's New!

CONTROL SYSTEMS, panel boards: Information; Panellit, Inc. See adv't p. 333.

CONTROLLERS, pneumatic: Information; Fischer & Porter Co. See adv't p. 420.

COOLING TOWER: Bulletins; Hudson Engineering Corp. See adv't inside front cover.

COOLING TOWER FAN: Bulletin 1501; Hartzell Propeller Fan Co. See adv't p. 298.

CORROSION PROTECTION, based on coatings of liquid neoprene: Complete data; Pennsylvania Salt Manufacturing Co. See adv't p. 416.

DESALTING, electric: Complete information; Petrolite Corp. See adv't p. 322.

DIAL THERMOMETERS, three types for any requirement: Bulletin 51-129; Palmer Thermometers, Inc. See adv't p. 433.

DIFFERENTIAL PRESSURE TRANSMITTER: Bulletin No. 98226; Taylor Instrument Companies. See adv't p. 318.

ELECTRIC MOTOR, variable speed: Bulletin; U. S. Electrical Motors, Inc. See adv't p. 398.

ENGINEERING & CONSTRUCTION, of refineries: "Lummus at Dunkirk" booklet; The Lummus Co. See adv't p. 317.

EXPANSION JOINTS: Bulletin 351; Zallea Brothers. See adv't p. 335.

FITTINGS AND FLANGES: Data sheets; Taylor Forge & Pipe Works. See adv't p. 411.

FITTINGS, forged steel, screw-end and socket-weld type: Literature; H. K. Porter Co., Inc. See adv't p. 394.

FITTINGS, welding: Catalog; Globe Steel Tubes Co. See adv't facing page 376.

FLOATING ROOF TANKS: Information; Chicago Bridge & Iron Co. See adv't p. 328.

FLOW METER, electronic: Bulletin 52-1074-222; The Hays Corp. See adv't p. 418.

GASHOLDER, dry seal type: Bulletin; General American Transportation Corp. See adv't p. 310.

HEAT EXCHANGERS: Bulletin; The Griscom-Russell Co. See adv't facing p. 344.

HEAT EXCHANGER TUBES: Publication B-2"; The American Brass Co. See adv't p. 329.

INDUSTRIAL TELEVISION, for boiler furnace, monitoring: Bulletin 1025 B; Diamond Power Specialty Corp. See adv't p. 437.

INSTRUMENTATION, centralized control by graphic panel: Bulletin 15-14; Minneapolis-Honeywell Regulator Co. See adv't pps. 342-343.

INSTRUMENT CHARTS: Catalog; Technical Charts Inc. See adv't p. 408.

INSULATION: Bulletin; The Philip Carey Mfg. Co. See adv't p. 327.

INSULATING FINISHING CEMENT, quick setting: Full details; Forty-Eight Insulations, Inc. See adv't p. 396.

LABORATORY WARE, of refractory Alundum: Bulletin 793; Norton Co. See adv't p. 320.

LUBRICANTS, for plug valves: Bulletin V-220; Nordstrom Valves, Rockwell Mfg. Co. See adv't pps. 336-337.

MANOMETER, micro-pressures and micro-flows: Descriptive literature & prices; Hastings Instrument Co., Inc. See adv't p. 430.

MIST ELIMINATORS, wiremesh: Catalog 13; Otto H. York Co., Inc. See adv't p. 420.

MIXERS, side and top entering, also laboratory types: Catalogs; Mixing Equipment Co., Inc. See adv't p. 356.

OXYGEN-NITROGEN GENERATORS: Information; Air Products, Inc. See adv't p. 388.

PAINT, guide for selection: Brochure B-770; The Sherwin-Williams Co. See adv't p. 435.

PIPE, steel, Saran-lined, corrosion-resistant: Catalog on Pipe, Valves and Fittings; Saran Lined Pipe Co. See adv't p. 404.

POROUS PLATES AND TUBES, refractory Alundum: Bulletin 140; Norton Co. See adv't p. 320.

PRESSURE TRANSMITTER, in the micro-range: Bulletin 154; Askania Regulator Co. See adv't p. 439.

PROCESS-CONTROL SYSTEMS, automatic: Brochure; Engineering Research Associates. See adv't p. 432.

PUMPS, controlled volume: Information and help on specific process problems; Milton Roy Co. See adv't p. 353.

PUMPS, rotary, positive displacement: "Facts" booklet; Blackmer Pump Co. See adv't p. 430.

PUMPS, screw type: Bulletin SE-5; Sier-Bath Gear & Pump Co., Inc. See adv't p. 434.

PUMPS, vertical centrifugal: Bulletin B-33; Johnston Pump Co. See adv't p. 316.

PURIFIERS, to stop entrainment losses: Information; The V. D. Anderson Co. See adv't p. 427.

RADIATORS, for engine jacket water and lube oil cooling: Details; Young Radiator Co. See adv't p. 297.

REFRACTORY SHAPES: Bulletin 1409; Norton Co. See adv't p. 320.

SAFETY HEADS, for pressure vessels, with rupture discs: Complete Safety Head Catalog; Black, Sivalls & Bryson, Inc. See adv't p. 417.

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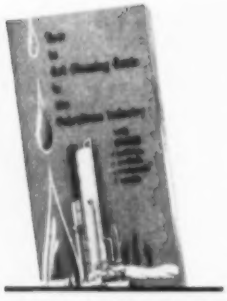

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PETROLEUM SERVICE DIVISION

What's New!

STEAM TRAPS: Information; Clark Manufacturing Co. See adv't p. 313.

STEAM TRAPS: Bulletin 152; W. H. Nicholson & Co. See adv't p. 408.

STEAM TRAPS, general: Catalog H; Armstrong Machine Works. See adv't p. 302.

STEAM TRAPS, impulse type: Bulletin T-1740; Yarnall-Waring Co. See adv't p. 414.

STORAGE TANK CLEANING: Booklet F-7629; Oakite Products, Inc. See adv't p. 438.

SULFUR RECOVERY, from waste hydrogen sulphide. New Stanolind process: Information; See adv't p. 352.

SWIVEL JOINTS, ball bearing type: Catalog 53-C; Chiksan Co. See adv't p. 348.

TANK CLEANING, with chemicals: Information; Dowell Inc. See adv't p. 312.

TANKS, calibrating: Bulletin CT-102; Warner Lewis Co. See adv't p. 436.

TEMPERATURE INDICATOR, eye level reading: Catalog; The Electric Auto-Lite Co. See adv't p. 436.

TEMPERATURE RECORDERS: Illustrated bulletins; The Foxboro Co. See adv't p. 339.

TOWER PACKINGS: Information on a reference manual; U. S. Stoneware Co. See adv't p. 407.

TUBE EXPANSION CONTROL SYSTEM: Information; Airetool Manufacturing Co. See adv't p. 405.

TUBE FITTINGS, for ultra-high vacuums: Information; Crawford Fitting Co. See adv't p. 432.

TURBINES, gear, close-coupled: Book B-4346; Westinghouse Electric Corp. See adv't p. 420.

TURBINES, mechanical-drive: Bulletin GEA-4955A; General Electric Co. See adv't pps. 314-315.

VALVES, packless diaphragm: New 53 Catalog; Crane Co. See adv't facing 345.

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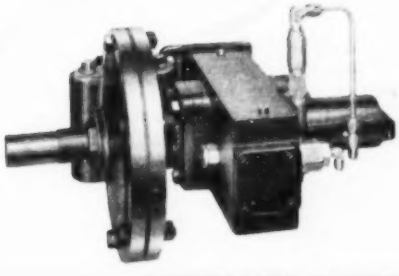

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EDITORIALS

Keep Plant Security Program Alive

IN WHATEVER reorganization of the work of PAD is contemplated at Washington consideration should be given to the petroleum industry's plant security program. If the work is to be dropped entirely even as a dormant function of PAD, then the API should again set up its committees so that they can function actively in the event of an emergency.

Much interest was displayed in this matter shortly after the outbreak of war in Korea. The API set up a special committee in 1950 to work out a program for the oil companies for protection against espionage and sabotage. A special API committee on Protection of Plant Facilities was organized early in 1951. It was decided, however, that PAD was the agency best qualified to develop a program for the oil industry and select the personnel to administer it. A Facilities Security Division was formed with W. R. Boyd III as director. He served as a civilian assistant to Rear Admiral Biggs in oil plant security work for both PAD and the Munitions Board. By 1952, however, the interest of all parties had waned and the PAD Division was reduced to an office.

As matters now stand the Munitions Board is the guardian of plant security for the petroleum and other industries with whom the government has essential contracts. In our industry the interest of the Munitions Board is principally in the plants making aviation gasoline. Its security measures might not be sufficient in the event of a sudden emergency.

For the industry as a whole there should be some form of organization with a program ready to be put into effect if conditions required. International relations are not at a point where this matter should go by default if PAD takes no further interest.

—V.B.G.

Bureau Backed the Wrong Horse

THE final report of the National Petroleum Council on the subject of synthetic liquid fuel costs was released last month in Washington. It further emphasizes the importance of a review of the entire Bureau of Mines Synthetic Liquid Fuel research program by Congress, before more public funds are appropriated for this work.

The oil industry study, made through the NPC, concludes that all methods of manufacture which have been proposed by the government agency are uneconomic under present conditions. Coal hydrogenation is deemed to require such drastic improvements that further work on this process does not appear to be justified.

Hydrogenation was selected by the Bureau technologists as the process for producing liquid fuels from coal on which most attention was to be given. Numerous laboratory and pilot plant investigations were made and a 200-bbl. coal hydrogenation demonstration plant was built at Louisiana, Mo. Cost studies of commercial plants were made by the Bureau and two cost estimates by outside engineering firms. The government's propaganda for a commercial synthetic liquid fuel industry in this country was largely based on production by coal hydrogenation.

The Bureau's work on coal gasification and the conversion of the resulting gas by modified Fischer-Tropsch synthesis, the alternate coal process, was not far enough along that the NPC could pass on this work in its first reports. Its final report, however, does cover the Fischer-Tropsch process, for which the Bureau of Mines lately built a 50-bbl. demonstration plant at Louisiana.

The NPC cost studies show a commercial plant investment of $380,000,000 required for Fischer-Tropsch processing, as compared with investment costs of $533,000,000 and $477,000,000, respectively for plants of the same capacity by conventional and modernized coal hydrogenation. Estimated gasoline costs by the Fischer-Tropsch route as given in the NPC report are lower than for either coal hydrogenation method. Steel requirements are estimated to be less for a Fischer-Tropsch plant.

There is some likelihood, says the NPC report, that continued research in oil shale and Fischer-Tropsch coal processing may further reduce the cost of liquid fuels produced by these methods. Because of the greater promise of these methods further government work on coal hydrogenation should not be undertaken, it is advised.

On the basis of the two and a half year study the National Petroleum Council conducted, in the course of which specialists in various scientific fields were called into service, it is evident the Bureau of Mines has backed the wrong horse in its synthetic liquid fuel program, at a cost to the public of many millions of dollars.

—V.B.G.

First Book About Oil

EVEN though Christmas is three months past, there is still snow on the ground—and it seems in order to comment on a most unique Holiday Season remembrance. This was a reproduction, made up by Ethyl Corp., of a booklet of 80 small-size pages written by Thomas A. Gale, "a resident of Oil Creek", in 1860. This was only a few months after the Drake well was drilled. The book, entitled "The Wonder of the Nineteenth Century, ROCK OIL", is believed to be the first written about the petroleum industry.

Under the circumstances, Author Gale did a very creditable job in getting information together on this new industry of producing "rock oil". What was at that time called "kerosine" was distilled from coal. He wrote of the geology of the oil region, gives costs of "raising the oil" and discusses markets for the new product for illumination. An appendix, of a few hundred words, tells refiners and distillers how to refine and treat the crude oil, from which an "experienced distiller may insure a product of from 85 to 90%".

Only three copies of Gale's book are known to be in existence. The copy in Ethyl Corp.'s collection of Petroleum Americana was reproduced in the original form and presented in an ingenious box cover.

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Packing: Rubber-lined Tank Cars, Rubber-lined Tank Trucks, also Carboys

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Grades or Strengths: Anhydrous
Packing: Multiwall Paper Bags, Fibre Drums

SODIUM SULFATE, Anhydrous
Grades or Strengths: Standard, approximately 99.5% Na_2SO_4
Packing: Multiwall Paper Bags

TRISODIUM PHOSPHATE
Grades or Strengths: Coarse, thru 10 on 20 mesh; Medium, thru 20 mesh on 100 mesh; Standard, thru 20 mesh, 15-25% thru 100 mesh; Fines, thru 40 mesh, 50% thru 100 mesh; Flake.
Packing: Multiwall Paper Bags, Fibre Drums

TETRASODIUM PYROPHOSPHATE
Grades or Strengths: Anhydrous, Powdered, 100% thru 20 mesh, 90% min. thru 100 mesh
Packing: Multiwall Paper Bags, Fibre Drums

SODIUM TRIPOLYPHOSPHATE
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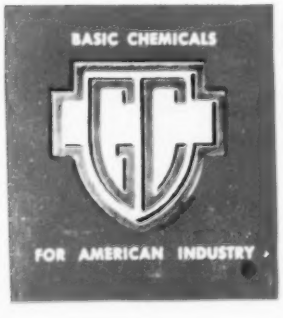

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